RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

EDITOR

Howard P. Doub, M.D.
Detroit, Michigan

Volume 55

July—December 1950

Owned and Published as its Official Journal by
THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

610.5
R118
v.4 55

Copyrighted, 1950, by the
Radiological Society of North America, Inc.

May 24 1951
UP

RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

Vol. 55 JULY, 1950 No. 1

CONTENTS

NON-SIGNIFICANT VENTRICULAR SHIFT IN PNEUMOENCEPHALOGRAMS, WITH PARTICULAR REFERENCE TO BOWING OF THE SEPTUM PELLUCIDUM.
D. C. Eaglesham, M.D. 1

PRIMARY TUMORS OF THE SMALL INTESTINE.
Edward L. Jenkinson, M.D., William H. Pfisterer, M.D., and Ernest R. Seitz, M.D. 12

GENERAL CONSIDERATIONS IN THE ROENTGEN EXAMINATION OF THE COLON.
Joseph C. Bell, M.D. 20

HIGH RENAL ECTOPIA AND CONGENITAL DIAPHRAGMATIC HERNIA.
Felix G. Fleischner, M.D., Samuel A. Robins, M.D., and Morris Abrams, M.D. 24

HIGH-VOLTAGE TECHNIC IN THE DIAGNOSIS OF POLYPOID GROWTHS OF THE COLON.
Cesare Gianturco, M.D. 27

ACROMIOCLAVICULAR CHANGES IN PRIMARY AND SECONDARY HYPERPARATHYROIDISM.
Louis Nathanson, M.D., and Morris Slobodkin, M.D. 30

ROENTGEN DIAGNOSIS OF SUBDIAPHRAGMATIC ABSCESS. *Paul S. Friedman, M.D.* 36

TREATMENT OF ANTRAL CANCER BY COMBINED SURGERY AND RADIUM THERAPY.
Vincent P. Collins, M.D., and John L. Pool, M.D. 41

TREATMENT OF CARCINOMA OF THE NASOPHARYNX BY IRRADIATION.
Theodore P. Eberhard, M.D., and Robert H. Leaming, M.D. 46

SUPERVOLTAGE ROENTGEN THERAPY IN CANCER OF THE MOUTH AND THROAT.
Milford D. Schulz, M.D. 52

SURGICAL MANAGEMENT OF CERVICAL LYMPH NODE METASTASES.
Grantley Walder Taylor, M.D. 60

TREATMENT OF CERVICAL LYMPH NODE METASTASES WITH IRRADIATION ALONE.
Charles L. Martin, M.D. 62

ROENTGEN DEMONSTRATION OF THE COMMON DUCT ENTERING A DUODENAL DIVERTICULUM.
Hugh S. Collett, M.D., Wallace S. Tirman, M.D., and Harold D. Caylor, M.D. 72

ELECTROKYMOGRAPHIC OBSERVATIONS IN CONSTRICTIVE PERICARDITIS.
Frederick G. Gillick, M.D., and William F. Reynolds, M.D. 77

RETROPERITONEAL EMPHYSEMA FROM PERFORATION OF AN INTRAPERITONEAL VISCUS.
Gordon J. Culver, M.D., and Joseph P. Concannon, M.D. 86

CLINICAL STUDIES OF THE USE OF EMULSION OF ETHYL IODOPHENYLUNDECYLATE (PANTOPAQUE).
Everett L. Pirkey, M.D., Edsel S. Reed, M.D., and William H. Smith, M.D. 89

NEW BONE FORMATION ASSOCIATED WITH DIRECT EXTENSION FROM LYMPH NODE METASTASES TO BONE IN INFILTRATING CARCINOMA OF THE BLADDER.
John M. Phillips, M.D. 94

NEW TRENDS IN RADIOGRAPHIC SCREENING TECHNICS UTILIZING SCHMIDT OPTICAL SYSTEMS AND HIGH-SPEED DEVELOPMENT. *Russell H. Morgan, M.D.* 97

A NEW TYPE OF X-RAY CASSETTE CABINET.
George Levene, M.D., and Lt. Col. Charles B. Perkins, M.C. 101

ACQUIRED RADIORESISTANCE OF THE CRYPT EPITHELIUM OF THE DUODENUM.
Margaret A. Bloom, M.S. 104

THE RADIOLOGIST AND THE FUTURE. *Eugene P. Pendergrass, M.D.* 116

EDITORIALS: NEW DEVELOPMENTS IN THE CANCER FIELD. *Shields Warren, M.D.* 119

RADIOLOGICAL DEFENSE. *R. R. Newell, M.D.* 124

ANNOUNCEMENTS AND BOOK REVIEWS. 125

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES. 130

ABSTRACTS OF CURRENT LITERATURE. 133

RADIOLOGY

A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

EDITOR
HOWARD P. DOUB, M.D.
Henry Ford Hospital, Detroit 2, Mich.

ASSOCIATE EDITORS
John D. Camp, M.D.
Hugh F. Hare, M.D.

EDITORIAL ASSISTANTS
Marion B. Crowell, A.B.
Florence E. Roper, A.B.

PUBLICATION COMMITTEE
Harold W. Jacox, M.D., Chairman
Leo G. Rigler, M.D.
George L. Sackett, M.D.

ADVISORY EDITORIAL BOARD
Harold Cummins, Ph.D.
Edith H. Quimby, Sc.D.
Arthur Purdy Stout, M.D.

GENERAL INFORMATION

RADIOLOGY is entered as second class matter at Syracuse, New York, and Easton, Penna., under the Act of August 24, 1912, and accepted November 24, 1934. RADIOLOGY is published by the Radiological Society of North America as its official Journal. Subscription rate $8.00 per annum. Canadian postage, $1.00 additional. Foreign postage, $2.00 additional. Single copies $1.00 each. All correspondence relative to business matters connected with the Radiological Society of North America and RADIOLOGY, or remittance for non-member subscriptions, should be made payable to the Radiological Society of North America and should be addressed to the BUSINESS MANAGER, DONALD S. CHILDS, M.D., 713 E. GENESEE STREET, SYRACUSE 2, NEW YORK. In requesting change of address, both the old and the new address should be given.

Dues to the Radiological Society of North America include subscription to RADIOLOGY and should be paid to DONALD S. CHILDS, M.D., SECRETARY-TREASURER, 713 E. GENESEE STREET, SYRACUSE 2, N. Y.

The rate for "want" advertisements for insertion in the Classified Section is 8 cents per word, minimum charge $2.00. Remittance should accompany order. Rates for display advertisements will be furnished upon request.

Inquiries regarding the program for the Annual Meeting of the Society for the current year should be sent to the President.

RADIOLOGY is published under the supervision of the Publication Committee of the Radiological Society of North America, which reserves the right to reject any material submitted for publication, including advertisements. No responsibility is accepted by the Committee or the Editor for the opinions expressed by the contributors, but the right is reserved to introduce such changes as may be necessary to make the contributions conform to the editorial standards of RADIOLOGY. Correspondence relating to publication of papers should be addressed to the Editor, HOWARD P. DOUB, M.D., HENRY FORD HOSPITAL, DETROIT 2, MICHIGAN.

Original articles will be accepted only with the understanding that they are contributed solely to RADIOLOGY. Articles in foreign languages will be translated if they are acceptable. Manuscripts should be typewritten, double-spaced, with wide margins, on good paper, and the original, not a carbon copy, should be submitted. The author's full address should appear on the manuscript. It is advisable that a copy be retained for reference as manuscripts will not be returned.

Illustrations and tables should be kept within reasonable bounds, as the number which can be published without cost to the author is strictly limited. For excess figures and for illustrations in color, estimates will be furnished by the Editor. Photographic prints should be clear and distinct and on glossy paper. Drawings and charts should be in India ink on white or on blue-lined coordinate paper. Blueprints will not reproduce satisfactorily. All photographs and drawings should be numbered, the top should be indicated, and each should be accompanied by a legend with a corresponding number. Authors are requested to indicate on prints made from photomicrographs the different types of cells to which attention is directed, by drawing lines in India ink and writing in the margin. The lines will be reproduced, and the words will be set in type. Attention should be called to points which should be brought out in completed illustrations, by tracings and suitable texts. These instructions should be concise and clear.

As a convenience to contributors to RADIOLOGY who are unable to supply prints for their manuscripts, the Editor can arrange for intermediate prints from roentgenograms.

The Society will furnish fifty reprints to authors, for which arrangements must be made with the Editor.

Contents of RADIOLOGY copyrighted 1950 by The Radiological Society of North America, Inc.

RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

Vol. 55 JULY 1950 No. 1

Non-Significant Ventricular Shift in Pneumoencephalograms[1]

With Particular Reference to Bowing of the Septum Pellucidum[2]

D. C. EAGLESHAM, M. D.

Guelph, Ontario

MOST BRAIN TUMOURS and other intracranial space-occupying lesions so crowd the affected cerebral hemisphere that it bulges to the healthy side. The ventricles shift with respect to the sagittal plane of the skull, and the lateral ventricle of the affected hemisphere usually will be found to be smaller than that of the normal hemisphere. The degree of shifting is ordinarily judged by the position of the septum pellucidum. Conversely, in an atrophic process one may sometimes see a shift of the ventricles to the affected side and here again the position of the septum pellucidum is usually taken as an index of the severity of the lesion. Asymmetry of the skull and rotation due to improper positioning are factors to be eliminated in each case before deciding that the shift is a real one.

It is not generally appreciated that ventricular shifts may appear in pneumoencephalograms in the absence of causative space-occupying or atrophic lesions. Displacements of such a nature, which should be recognized as clinically non-significant, form the subject of this paper. Representative cases fall into three broad groups: first, those with unequal filling of the lateral ventricles; second, those associated with subdural gas; third, those encountered in a follow-up examination after twenty-four hours or more.

GROUP I: NON-SIGNIFICANT VENTRICULAR SHIFT WITH UNEQUAL FILLING OF THE LATERAL VENTRICLES

In the average encephalographic study there is shown in the initial frontal view approximately equal filling of the lateral ventricles. Inequality of filling, with displacement to the side of the smaller ventricle, should arouse suspicion of collapse of the latter from a technical fault in the procedure. A possible cause for such a happening may be the removal of a considerable quantity of cerebrospinal fluid before gas is injected. In the experience of the author this may lead to lack of filling of the lateral ventricles, to unilateral filling with collapse of the unfilled ventricle, or to unequal filling. The better filled ventricle may then be found to be shifted to the opposite side, as judged from the position of the septum pellucidum. Unless this consideration is kept in mind one may be led to the erroneous diagnosis of a space-occupying lesion.

[1] Including ventriculograms.

[2] From the Department of Radiology, Guelph General Hospital, Guelph, Ontario, Canada. The cases presented were seen at the Basingstoke Neurological and Plastic Surgery Hospital, Royal Canadian Army Medical Corps in England. Presented at the First Annual Meeting of the Canadian Neurological Society at Montreal, P. Q., May 20, 1949. Accepted for publication in July 1949.

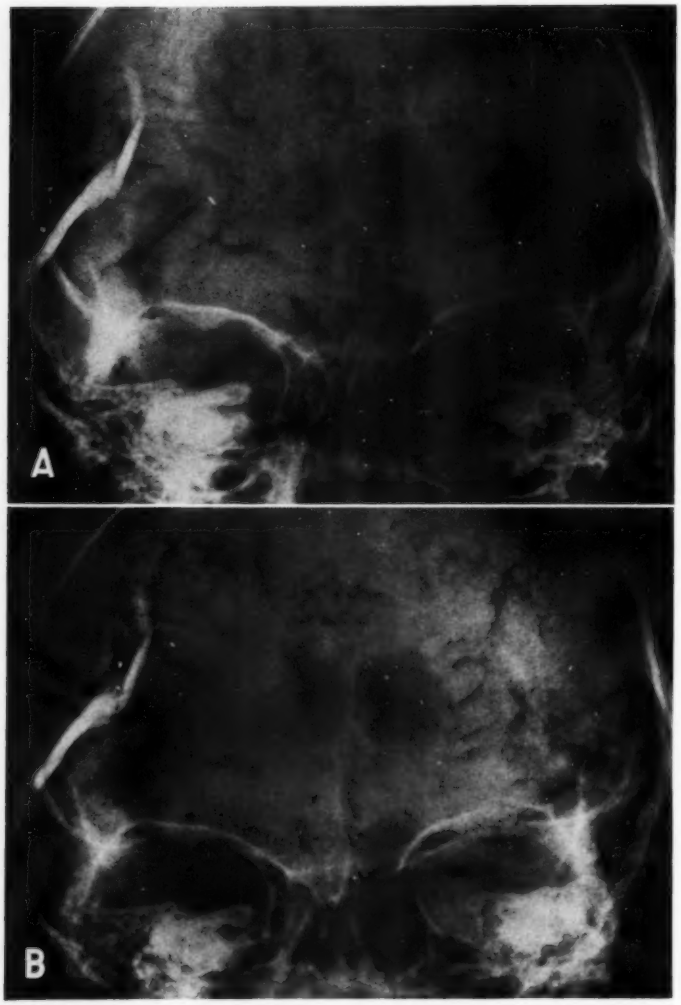


Fig. 1. Case 1. A. Unequal filling of the lateral ventricles, the right lateral ventricle being considerably smaller than the left. A shift of the ventricles 4 mm. to the right is present as judged by the position of the septum pellucidum, which is bowed slightly to the right. The arrow indicates a grossly depressed right parietal fracture sustained four months previously.

B. Following agitation of the head, the lateral ventricular filling is equalized and the ventricles are now symmetrical, with no shift. The shift in Fig. 1A was evidently due to unequal filling with partial collapse of the right lateral ventricle.

The clue lies in the shape of the septum pellucidum. If it is found to be bowed, with the convexity toward the less well filled ventricle, the shift should be regarded as an artificial one and the diagnosis of a space-occupying mass may usually be discarded. In such an event, it may be possible by manipulation of the head to transfer sufficient gas to equalize the filling, and the ventricles may then be found to be normally situated (Case 1). If this manoeuvre is ineffective, it may be advisable to repeat the encephalogram to make the diagnosis clear.

The following cases are examples of this variety of shift. It is seen that the septum

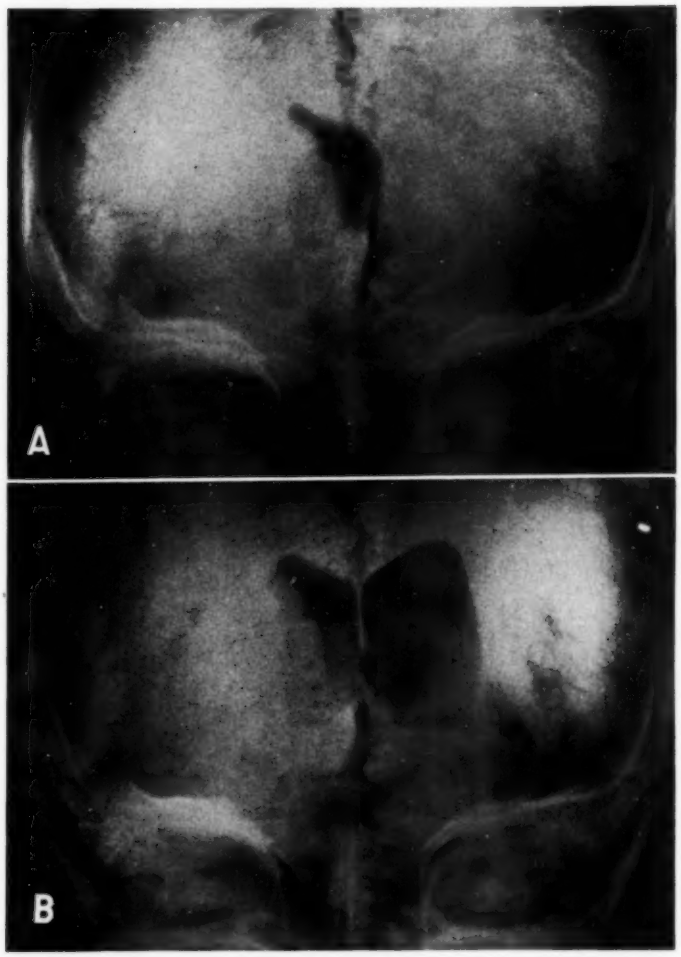


Fig. 2. Case 2. A. Filling of right lateral ventricle only, with slight bulge of the septum pellucidum. Ventricular shift 5 mm. to the left interpreted as non-significant, due to unilateral filling.

B. Repeat encephalogram twenty-six days later. The lateral ventricles are approximately equally filled and there is no shift of the septum pellucidum. The left ventricle is slightly enlarged. The picture was interpreted as indicating a slight left frontal and parietal atrophic process.

pellucidum, although bowed and displaced across the midline, is not oblique as it usually appears when displaced by a mass such as a tumour.

CASE 1: W. G., male, 39 years of age, was admitted with depression of the skull as a result of a fall four months previously. The injury had produced mild symptoms only, despite a severe depression of the right parietal bone. Neurologic examination at the time of admission was negative.

An encephalogram (Fig. 1A) showed initially a small, poorly filled right lateral ventricle, with a shift of the ventricles 4 mm. to the right as measured at the septum pellucidum. A severe depression of the right parietal bone was demonstrable (arrow). Manipulation of the head was successful in equalizing the ventricular filling. The ventricles were then found to be symmetrical in their anterior horns and anterior portions of their bodies, with no shift (Fig. 1B).

CASE 2: E. M., male, 24 years of age, was knocked unconscious by a head injury in a car accident. Neurologic examination showed a dilated right pupil and flaccid extremities. Blood was found in the spinal fluid. X-ray examination demonstrated

diastasis of the sagittal and metopic sutures, with one fracture entering the left frontal sinus. Recovery began promptly, and two days later neurological examination was reported as essentially negative.

An encephalogram (Fig. 2A) nine days after injury demonstrated filling of the right lateral ventricle only, with a shift 5 mm. to the left as judged by the septum pellucidum, which was bowed slightly to the left. The shift was interpreted as not significant in view of probable collapse of the left ventricle with unequal drainage of the ventricles. Attempts to transfer gas to the left ventricle by manipulation of the head were unsuccessful.

A second encephalogram (Fig. 2B), a month later, showed almost equal filling of the lateral ventricles with no shift. The left ventricle was now found to be slightly enlarged in its anterior horn, body, and atrium. The radiologic interpretation was that the patient had a slight left frontal and parietal atrophic process presumably due to the injury.

Comment: An example of non-significant shift due to unequal filling presumably associated with unequal drainage of the lateral ventricles.

GROUP II: NON-SIGNIFICANT SHIFT IN THE PRESENCE OF SUBDURAL GAS

Gas in the cranial subdural space may be responsible for unusual effects upon the ventricles. Its recognition is important so that the ventricular abnormality will not be ascribed to another cause. Subdural gas may simulate gas in the subarachnoid space and may erroneously be interpreted as evidence of a cerebral atrophic process. Free mobility with change of posture is a characteristic of subdural gas helpful in distinguishing it from gas in the subarachnoid space. A fluid level is frequently seen with large subdural collections. The falx cerebri and the tentorium may be outlined clearly.

The incidence of subdural gas collections in routine encephalograms varies considerably with the technic in use. Paul and Erickson (1) report its presence 50 times in 78 consecutive encephalograms. These authors draw attention to ventricular collapse in the presence of large collections of subdural gas particularly at the twenty-four-hour examination. Further, they describe an association of unilateral subdural filling with depression, distortion, and narrowing of the homolateral ventricle.

It is well to be aware of the fact that a unilateral subdural gas collection above the tentorium may be associated with a non-significant ventricular shift to the opposite side. Measurement of the shift is not complicated by bowing of the septum pellucidum. Case 3 is an example.

CASE 3: R. F., male, aged 29, was admitted unconscious on the day he was injured in a motorcycle accident. Neurologic examination showed muscular response to painful stimuli. X-ray films demonstrated a fracture of the right neck of the mandible and depression of the right malar arch. Gradual improvement occurred during the two weeks subsequent to admission but the patient remained lethargic and irritable.

An encephalogram (Fig. 3A) two weeks after injury showed very small lateral ventricles displaced 6 mm. to the left. The septum pellucidum showed no bowing. A large collection of subdural gas was present over the convexity of the right cerebral hemisphere. This was interpreted as partial collapse of the lateral ventricles with ventricular shift due to a subdural gas collection.

A second encephalogram (Fig. 3B), eleven days later, showed the ventricles to be normal in size, with no asymmetry and no shift.

Comment: An example of non-significant shift due to asymmetrical subdural gas collection with partial collapse of the lateral ventricles.

GROUP III: NON-SIGNIFICANT SHIFT AT THE SECOND-DAY EXAMINATION OR LATER

Lateral ventricles shown to be symmetrical in the first examination may be asymmetrical in a follow-up examination after an interval of twenty-four hours or more. A marked shift to one side, as judged by the septum pellucidum, may be present. Although a clear explanation for such changes is not yet forthcoming, it is important to recognize that they are not ordinarily of any clinical significance.

Asymmetry seen at twenty-four hours is usually most noticeable in the anterior horns and anterior portion of the bodies of the lateral ventricles as viewed in the frontal projection. One ventricle may be found to have become enlarged in its transverse diameter while the other will usually show a reduction of a corresponding degree (Case 4). The septum pellucidum will fre-

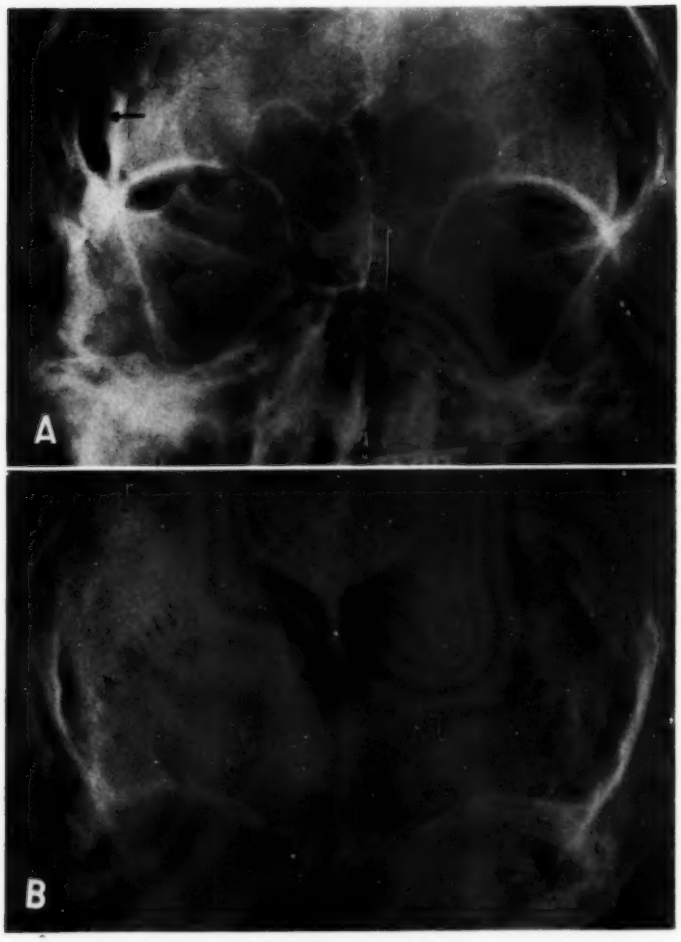


Fig. 3. Case 3. A. Very small lateral ventricles displaced 6 mm. to the left as measured from the septum pellucidum. No septal bulge. Large subdural gas collection over right hemisphere (arrow). Interpreted as non-significant shift due to asymmetrical subdural gas distribution with some ventricular collapse as well.

B. Second encephalogram eleven days later. Ventricles now normal in size with no asymmetry and no shift.

quently be bowed strongly to the side of the smaller ventricle, and the general appearance is often identical with that observed in the cases discussed in Group 1. If sufficient gas is present, follow-up examination at forty-eight hours or seventy-two hours may show the previously small ventricle to be the larger one. It is apparent that the septum pellucidum may oscillate from side to side, crossing the midline for a distance of 1.0 cm. or more, with extreme distortion (Case 5).

CASE 4: A. F., male, aged 22, suffered a head injury with retrograde amnesia of two hours and post-traumatic amnesia of sixteen hours. No fractures were demonstrated. A suspicion of subdural hematoma led to bilateral trephining of the skull. No hematoma was found, but the arachnoid was adherent and edematous. An encephalogram (Fig. 4A) three weeks after injury showed symmetrical generalized dilatation of the lateral ventricles with no shift.

A follow-up examination at twenty-four hours (Fig. 4B) revealed a marked septal bulge to the left with further enlargement of the right lateral ventricle and diminution of the left ventricle. These

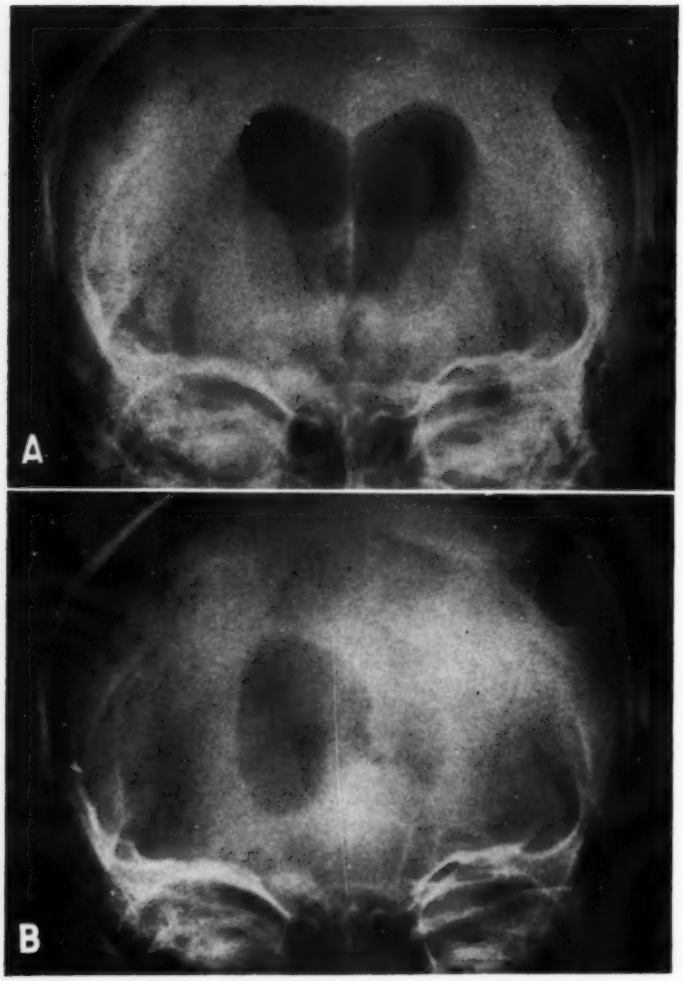


Fig. 4A and B. Case 4. A. Symmetrical lateral ventricular enlargement with no shift of the ventricles.
B. Twenty-four-hour follow-up examination showing a marked septal bulge to the left, with widening of the right lateral ventricle and diminution of the left ventricle, interpreted as not significant clinically.

twenty-four-hour changes were interpreted as not being clinically significant.

In a subsequent encephalogram (Fig. 4C), six weeks after injury, the appearance of the ventricles was identical with that in the original initial film (Fig. 4A). The ventricular dilatation may have been caused by an atrophic process secondary to trauma or possibly by adhesive arachnoiditis.

CASE 5: G. A., male, 30 years old, was knocked down by a truck on Nov. 24, 1943, receiving a severe head injury. Bilateral parietal fractures were demonstrated radiologically. Persistent headache following the injury led to operative disclosure of a large subdural hygroma three weeks later.

The patient was discharged from the hospital two months after injury but was readmitted on Aug. 31, 1944, because of continuing headache. An encephalogram at that time (Fig. 5A) showed an almost symmetrical enlargement of the lateral ventricles, of moderate degree, with the septum pellucidum in the midline. The third ventricle was moderately widened. No subarachnoid cortical markings were seen. A follow-up examination (Fig. 5B) after twenty-four hours demonstrated a slight bulge of the septum pellucidum to the right. At forty-eight hours (Fig. 5C), the bulge was more pronounced. Examination at seventy-two hours (Fig. 5D) showed considerable gas remaining in the ventricles

Fig. 4C. Case 4. Encephalogram made three weeks after that in Fig. 4B, showing an appearance identical with that in Fig. 4A, confirming the interpretation given.

but at this time the septum was found to be bowed strongly to the left. The right ventricle was then considerably larger than the left. Some gas remained in the ventricles for eight days.

Another encephalogram (Fig. 5E), Dec. 1, 1944, showed the lateral ventricles and third ventricle to be slightly larger than at the examination of Aug. 31. Serial examination revealed retention of gas in the lateral ventricles for thirteen days, and at no time could any sulci be demonstrated. A radiologic interpretation of adhesive arachnoiditis with progressive hydrocephalus was made. This was confirmed by operative exposure through burr holes on Dec. 7, at which time there was demonstrated almost complete obliteration of the subarachnoid cortical spaces by adhesive arachnoiditis.

The interpretation placed on the septal bulge to the right (Figs. 5B and 5C) and to the left (Fig. 5D) in the days following the initial encephalogram was that it was not in itself significant clinically.

Comment: Non-significant shift at twenty-four, forty-eight, and seventy-two hours, respectively, with oscillation of the septum pellucidum.

DISCUSSION

Schatzki, Baxter, and Troland (2), reporting on second day encephalography with particular reference to the size of the ventricles, have described enlargement at that time in 23 out of 60 cases. Evans (3), on serial observation, noted a slight increase in the size as the usual finding at twenty-four hours. Paul and Erickson (1), however, found that the ventricles were usually smaller at twenty-four hours, particularly if there was a large escape of gas into the cranial subdural space.

The discrepancy in these reports is probably due to differences in the technic of examination. Paul and Erickson examined their patients in the upright position, whereas the other writers used the recumbent position.

Bulging of the septum at the twenty-four hour examination was found in 8 of the cases of Schatzki, Baxter, and Troland (2). It was observed only in patients with dilated ventricles, but no apparent relation between the side of the greatest brain loss and the direction of the bulge was found. These authors suggest that there is a change in the shape of the ventricles from day to day and that they may not be so fixed in shape and size as they are usually considered to be.

Without more proof it is hazardous to accept this suggestion that the ventricles change in shape from day to day in the absence of gas. The mechanical conditions imposed on the brain by a mixture of gas and fluid in the subarachnoid space, and frequently in the subdural space as well,

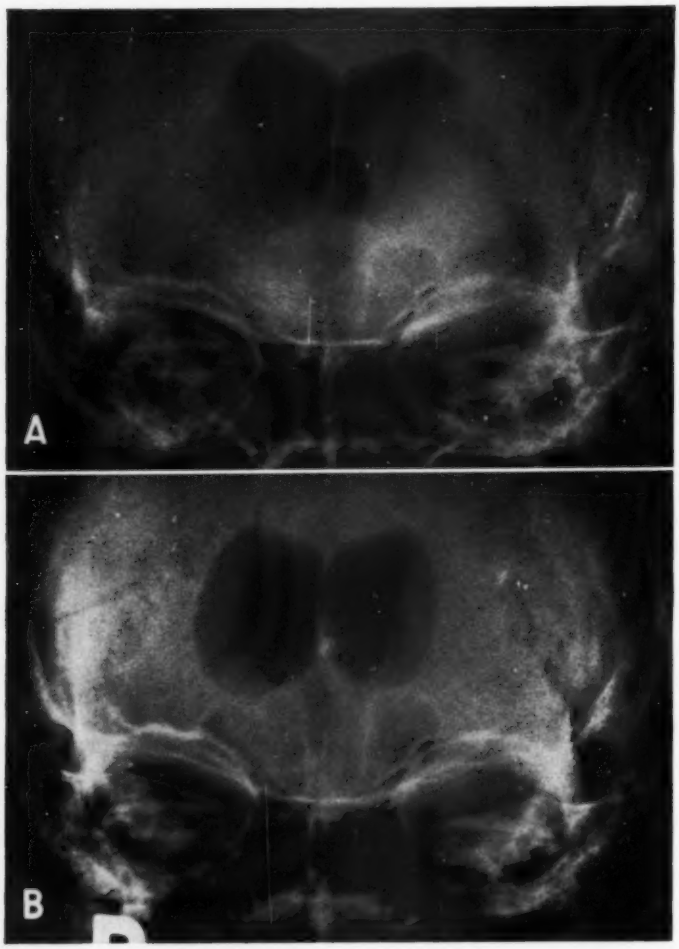


Fig. 5A and B. Case 5. A. Almost symmetrical enlargement of lateral ventricles and moderate widening of the 3rd ventricle with no shift. No filling of the sulci.
B. Twenty-four-hour follow-up examination showing slight septal bulge to the right.

are so far from physiological that for the present it would be best to consider the ventricles relatively fixed except in the presence of a progressive space-occupying or atrophic lesion. At postmortem examinations one does not encounter ventricles of the shape, size, and position illustrated in Figure 4B except in the presence of an obstructive lesion of an interventricular foramen. It may be that an excretory opaque medium will be developed for the choroid plexus paralleling those for the liver and kidneys. One may then talk in terms of the more nearly normal physiological state of the ventricular system.

The mechanism of the distortion of the ventricles at the twenty-four-hour examination is not entirely clear. The posture assumed by the patient after the initial examination might well be the only factor responsible. Recumbency, with the head resting on one side for the major portion of the interval between examinations, may cause unequal drainage of the gas from the lateral ventricles and this might be expected to result in some asymmetry.

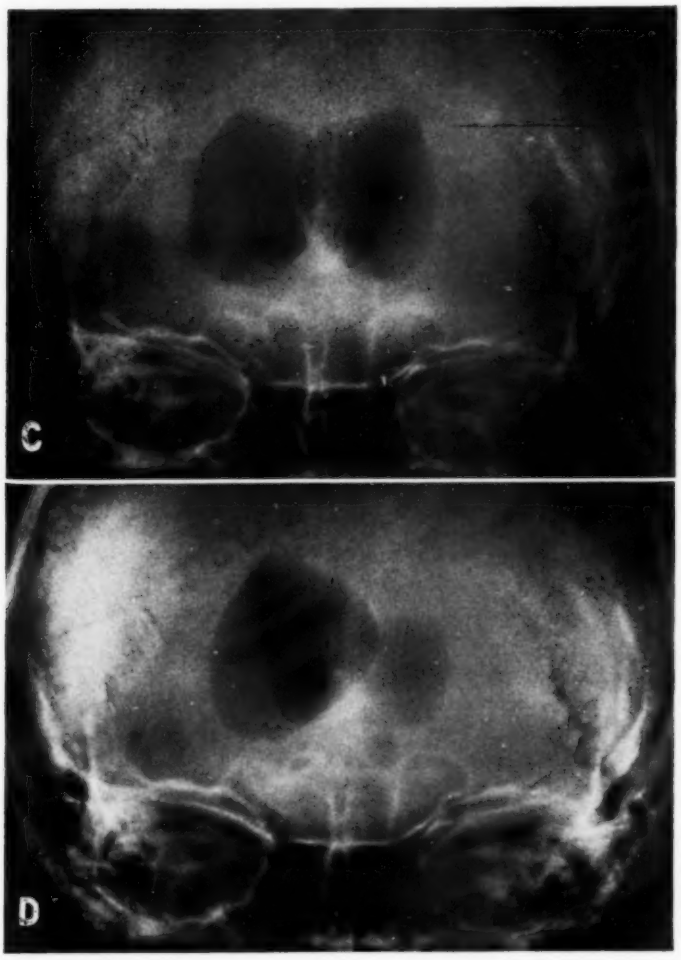


Fig. 5C and D. Case 5. C. Appearance at forty-eight hours, showing more pronounced bulge to the right.
D. Reversal of the bulge at seventy-two-hour follow-up examination, with the right ventricle now considerably larger than the left.

The value of second-day encephalography is chiefly in the occasional demonstration of a porencephalic cyst not visible in the initial examination. Apart from this, it is unusual to encounter any findings of pathological interest. One might expect occasionally to find symmetry of the ventricles at the twenty-four-hour examination where asymmetry was present initially, because of equalization of filling in the interval.

The interpretation to be placed on the finding of asymmetrical ventricles at the twenty-four examination in cases where no asymmetry was present in the first examination is worthy of comment. I believe it erroneous in such cases to consider that an atrophic lesion is present on the side of the larger ventricle at the second-day examination. Case 5, which shows oscillation of the septum pellucidum from one side to the other, with enlargement of one ventricle at twenty-four hours and enlargement of the other at seventy-two hours, demonstrates the danger of possible false interpretation in this respect. The lateral ven-

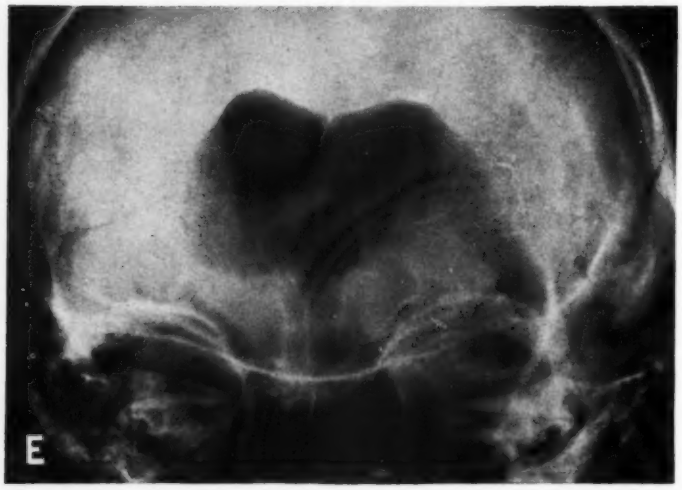


Fig. 5E. Case 5. An encephalogram three months after that in Fig. 5D, showing the ventricles to be midline in position, but with progression in the enlargement of the lateral and 3rd ventricles due to adhesive arachnoiditis.

tricles at the initial examination were enlarged but quite symmetrical (Fig. 5A). At the twenty-four-hour examination (Fig. 5B) one might be tempted to consider the presence of a severe unilateral atrophic process. The seventy-two-hour examination (Fig 5D), however, shows such a diagnosis to be untenable.

The incidence of non-significant shift based on the author's experience is roughly 2 per cent. Several cases other than those reported here have been seen but these have been less marked or otherwise unsuitable for reproduction. One will, of course, encounter more cases if a routine twenty-four-hour follow-up examination is made. During the time this series was collected the twenty-four-hour examination was not routinely made on every patient.

In the cases reported here, the examination was made with the patient recumbent and the x-ray beam vertical. Possibly an upright position might change the incidence of the finding.

SUMMARY

The purpose of this paper has been to point out the presence of ventricular shifts that are not clinically significant. These fall into three broad groups, in association with (1) unequal filling of the lateral ventricles; (2) subdural gas collections; (3) follow-up examinations at twenty-four hours or later.

Failure to recognize these "spurious" shifts and distortions may lead to the incorrect diagnosis of space-occupying lesions or unilateral atrophic lesions.

Guelph General Hospital
Guelph, Ontario

REFERENCES

1. PAUL, L. W., AND ERICKSON, T. C.: Observations on the Presence of Subdural Gas after Pneumoencephalography. Radiology **46:** 139–148, February 1946.

2. SCHATZKI, R., BAXTER, D. H., AND TROLAND, C. E.: Second-Day Encephalography, with Particular Reference to the Size of the Ventricles. New England J. Med. **236:** 419–428, March 20, 1947.

3. EVANS, W. A., JR.: An Encephalographic Ratio for Estimating the Size of the Cerebral Ventricles: Further Experience with Serial Observations, Am. J. Dis. Child. **64:** 820–830, November 1942.

SUMARIO

Insignificante Desviación Ventricular en los Neumoencefalogramas, con Referencia Particular al Arqueo del Tabique Pelúcido

No se aprecia generalmente el hecho de que pueden aparecer desviaciones ventriculares en los neumoencefalogramas en ausencia de lesiones que toman espacio o atróficas. Los desplazamientos de ese género, que deben ser reconocidos como desprovistos de importancia clínica, corresponden a tres grupos principales: (1) los acompañados de henchimiento desigual de los ventrículos laterales; (2) los asociados con la presencia subdural de gas; (3) los observados en un examen posterior al cabo de veinticuatro o más horas.

El henchimiento desigual de los ventrículos laterales puede proceder de algún defecto en la técnica. La clave en esos casos la ofrece la forma del tabique pelúcido o transparente. Si aparece arqueado, con la convexidad hacia el ventrículo menos lleno, hay que considerar la desviación como artificial y no indicativa de una lesión que ocupa espacio. La manipulación de la cabeza igualará frecuentemente el henchimiento.

La presencia subdural de gas puede simular gas en el espacio subaracnoideo y ser interpretada erróneamente como signo de un proceso atrófico en el cerebro. La movilidad libre al cambiar de postura establecerá la distinción.

La asimetría de los ventrículos, observable por primera vez en los encefalogramas de veinticuatro horas, no debe ser interpretada como signo de proceso atrófico en el lado del ventrículo mayor, dado que las radiografías subsiguientes pueden revelar asimetría del lado opuesto, al oscilar el tabique pelúcido de un lado al otro.

La falta de reconocimiento de esas "falsas" desviaciones y deformaciones puede conducir a un diagnóstico inexacto de lesión atrófica que toma espacio o unilateral.

Primary Tumors of the Small Intestine[1]

EDWARD L. JENKINSON, M.D., WILLIAM H. PFISTERER, M.D., and ERNEST R. SEITZ, M.D.
Chicago, Ill.

THE SMALL INTESTINE averages 22 feet in length and constitutes 75 per cent of the alimentary tract. The swing of the pendulum is toward a more extensive consideration of this portion of the gastro-intestinal tract. The reawakening of interest by Golden, Weber, Kirklin, and Schatzki has made us "small-bowel conscious."

Tumors of the small intestine, whether benign or malignant, are uncommon. Raiford reported 88 cases among 11,500 general autopsy records and 45,000 specimens from the surgical pathological department of Johns Hopkins Hospital, and Buckstein found 69 cases (35 benign, 29 malignant, and 5 unclassified) in 22,810 autopsies at Bellevue Hospital (New York). Shallow, Eger, and Carty, reviewing the literature from 1858 to 1939, collected a total of 137,174 general autopsies, among which there were 5,034 carcinomas of the large intestine, an incidence of 3.66 per cent, and 134 carcinomas of the small bowel, or 0.098 per cent, *i.e.*, approximately 36 carcinomas of the large to every 1 of the small intestine.

The largest single series of small intestinal tumors comes from the Mayo Clinic. Weber and Kirklin reported 41 benign lesions seen from 1907 to 1939 at that institution, while C. W. Mayo found 108 malignant tumors in the same period. In a thirty-year period at the Lahey Clinic, Ficarra and Marshall encountered 29 carcinomas of the small intestine. From the Western Infirmary of Glasgow, Fraser reported 13 malignant growths of the small bowel discovered in 22,975 operations on the gastro-intestinal tract and 2,674 autopsies in a decade.

In the ten years 1938–1948, at St. Luke's Hospital, Chicago, 16 small bowel tumors were encountered during operation or at autopsy, exclusive of tumors of the ampulla of Vater. Fifteen of the number were histologically verified as primary in the small intestine. The proportion of malignant tumors to benign was 3 to 1 (Table I). Both the benign and malignant types showed an equal sex distribution. Other investigators (Rankin and Newell; Cameron; Mayo) have found males to predominate 2 to 1.

TABLE I: BENIGN AND MALIGNANT LESIONS OF THE SMALL INTESTINE
(St. Luke's Hospital, Chicago, Ill., 1938–1948)

	Duodenum	Jejunum	Ileum	Multiple	Total
Malignant lesions					
Adenocarcinoma	4	2	2	0	8
Leiomyosarcoma	0	0	1	1	2
Carcinoid	0	0	1	1	2
TOTAL	4 (33.3%)	2 (16.6%)	4 (33.3%)	2 (16.6%)	12
Benign lesions					
Adenoma	3	0	0	0	3
Fibroma	0	0	1	0	1
TOTAL	3 (75%)		1 (25%)		4

The tumor most commonly found in this series was the adenocarcinoma, which occurred twice as often in the duodenum as in the jejunum or ileum. The second in order of incidence was the adenoma. All adenomas were surgically removed. It has been estimated that 7 per cent of

[1] Presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

adenomatous polyps undergo malignant change.

Tumors of the small bowel rarely manifest themselves either clinically or roentgenologically unless there is some degree of intestinal obstruction or bleeding. In this series, intussusception was present in 28 per cent of the tumors of the jejunum and ileum. In an adult, intussusception is usually precipitated by a tumor.

The need for early roentgenologic diagnosis cannot be overemphasized. General acceptance of the reliability of the serial study of the small intestine will result in earlier diagnosis and better prognosis. At operation most of our malignant cases showed extensive mesenteric involvement, and the prognosis was poor. This would seem to prove that much time had elapsed before the diagnosis was made, or that the patient was asymptomatic.

Fig. 1. Case 1: Duodenal carcinoma. Roentgenogram showing dilatation of duodenal bulb with adjacent area of narrowing.

TUMORS OF THE DUODENUM

The duodenum was the site of 7, or 43.7 per cent of the tumors constituting our series. Four of these were malignant and 3 benign. Two of the tumors were in the first portion of the duodenum; both were benign adenomas, correctly diagnosed roentgenologically. In the second portion of the duodenum there were 4 adenocarcinomas and 1 benign papilloma. No tumors were found in the third portion. According to Hoffman and Pack, the third portion is most commonly involved; they found that of 228 small intestinal carcinomas 45.6 per cent were located in the duodenum.

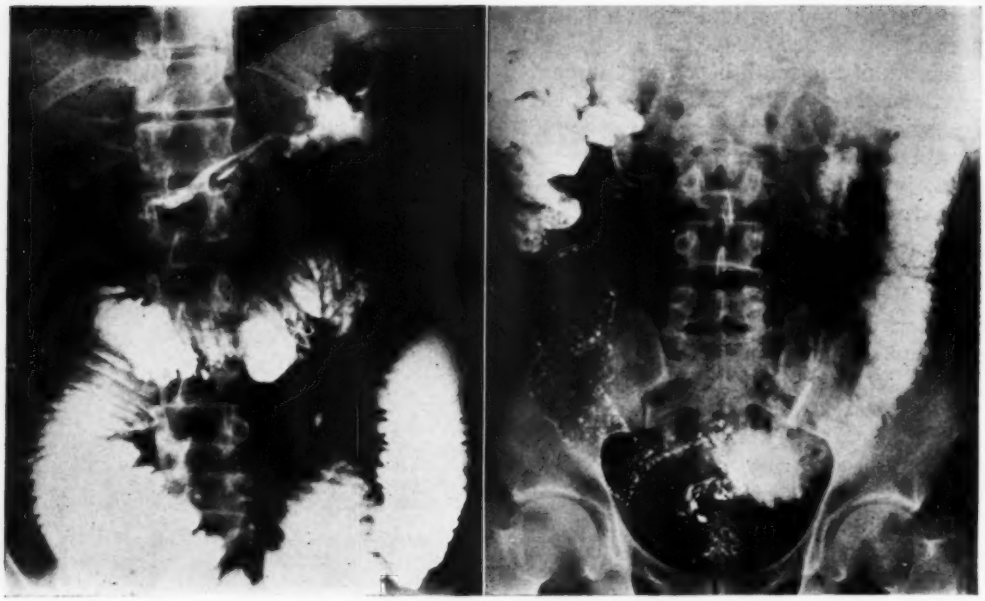
Tumors of the duodenum have been classified by Mateer and Hartman according to the location of the growth: (1) supra-ampullary, arising in that segment of the duodenum proximal to the papilla of Vater; (2) peri-ampullary, originating close to the papilla of Vater; (3) infra-ampullary, originating from the duodenal mucosa between the ampulla of Vater and the duodeno-jejunal junction.

The symptomatology in the supra-ampullary type simulated duodenal ulcer, with epigastric post-prandial pain commonly radiating to the back. Eating and antacids gave little or no relief. Bleeding, manifested by blood in the stool and hypochromic anemia, was occasionally found. The late symptoms were all related to pyloric obstruction.

In the peri-ampullary group the first symptom is often jaundice, or jaundice and pain concurrently. The jaundice is frequently intermittent but may be continuous. The associated pain is relieved by vomiting rather than by eating.

The early changes with tumors of the duodenum are often difficult to demonstrate roentgenologically. As the tumor enlarges, varying degrees of obstruction with narrowing or filling defects and dilatation of the intestine proximal to the lesion may occur, even to the point of gastric retention. Annular constriction was the most common finding. Surging and reverse peristalsis were also noted.

In one of our cases, where the tumor originated near the papilla of Vater, no roentgenologic evidence was found and the patient was explored for obstructive jaundice. Two of the adenomas were asymptomatic and were demonstrated roentgenologically as a part of a presurgical



Figs. 2 and 3. Case 2: Carcinoma of the jejunum.

gynecological study. A benign papilloma of the second portion of the duodenum showed a deformed mucosal pattern and a polypoid fold. The patient was examined because of intermittent epigastric pain and bright red and occult blood in the stool.

CASE 1: C. L., white male aged 72, had gastrointestinal symptoms beginning seven months prior to admission, including upper abdominal distress and loss of appetite. A month after onset of symptoms, a roentgen diagnosis of duodenal ulcer was made elsewhere. Pain continued, despite a rigid ulcer diet, with a rapid weight loss of 20 pounds.

Physical Examination: The liver was moderately enlarged, and there was tenderness to deep palpation in the periumbilical region. Jaundice was absent. No palpable masses were present. Blood studies were normal. The stools were negative for blood.

Roentgen Examination: The esophagus and stomach were negative. The duodenal bulb was dilated, and just distal to it was a sharply demarcated annular area of narrowing, suggesting an organic lesion, probably a carcinoma (Fig. 1).

Clinical Course: Surgery was refused and the patient returned to his home in another city, where he continued to work as a salesman for four months. An acute obstruction occurred, surgery was again refused, and death ensued three weeks later. Since autopsy was refused, we have no definite proof that the lesion was malignant. From our roentgen examination and subsequent developments, however, we feel quite certain that it was.

TUMORS OF THE JEJUNUM AND ILEUM

Tumors of the jejunum and ileum are considered together. There were but 2 jejunal tumors—both adenocarcinomas—comprising 12.5 per cent of the series. The tumors found in the ileum comprised 31 per cent of the total and included 2 adenocarcinomas, 1 leiomyosarcoma, 1 fibroma, and 1 carcinoid, a total of 5 cases.

The most common clinical symptoms of jejunal and ileal tumors are those of obstruction. Two of our series had dramatic episodes of intussusception. The remainder had varying degrees of obstruction characterized by cramping, colicky pain, vomiting, belching, and bloating. The pain was variable in location. Weight loss was associated with all the tumors except the carcinoid and was often marked. Hemorrhage, manifested by either blood in the stool or secondary anemia, was prominent in all except the fibroma.

The physical finding most frequently met was hyperperistalsis. A mass was palpable in 1 of the 7 cases. Perforation and

generalized peritonitis were present in 1 case on admission.

CASE 2: S. K., white male aged 59, had a ten-week history of periumbilical pain and vomiting and a 35-pound loss of weight. Pain was accompanied by a sense of gnawing and rumbling in the abdomen lasting one minute. Emesis of a green-stained material relieved the pain. The gallbladder and appendix had been removed one year earlier. The stools were of normal color, and a relative constipation was relieved by cathartics.

Physical Examination: Hyperperistalsis heralded the pain. No masses were palpable. There were moderate abdominal rigidity and distention. Blood studies were normal. Stool examination (benzidine) was positive for occult blood, 4 plus.

Roentgen Examination: Initial recumbent and upright films showed minimal gaseous distention of the proximal small intestine. Twenty-four hours later a small-bowel study demonstrated a normal esophagus, stomach, and large duodenal bulb. The duodenum and jejunum were markedly dilated, with an obstructing lesion 2 feet from the ligament of Treitz, allowing only a trickle of barium to pass through the narrowed lumen (Fig. 2). One hundred hours later most of the barium had passed the point of obstruction. The colon examination was negative.

The clinical and roentgen findings suggested a tumor in the jejunum, possibly malignant (Fig. 3).

Operation: An annular constricting tumor was found 2 feet below the ligament of Treitz. The proximal bowel was markedly dilated and the distal bowel collapsed. There were infiltration and enlarged nodes in the mesentery at this point. The tumor was exteriorized and a jejunostomy was performed below the level of the obstruction. Three operations followed, including an enterostomy, removal of the tumor, and an opening through the spur of the double-barreled jejunostomy. The patient died three months after the last procedure, with generalized abdominal metastasis.

Pathological Report: Constricting glandular carcinoma of the jejunum; marked edema of the wall and dilatation of the lumen of the small bowel.

We were able to confirm in this case Golden's experience that no damage arises from the administration of barium by mouth in the presence of a tumor of the small intestine, even when there is a marked constriction.

CASE 3: E. O., white female aged 70, complained, on admission, of severe periumbilical pain, nausea and vomiting, constipation, enterorrhagia, and a 30-pound weight loss. Three months earlier there had been a sudden onset of severe abdominal pain, increasing in intensity to a maximum, then subsiding only to recur. This cyclic syndrome continued intermittently for three days. There were associated vomiting, becoming fecal, and dark blood in the stool changing to bright red. On the fourth day, "something broke loose in the abdomen with audible gurgling." Emesis and pain ceased. The patient was then bedridden for one week, gradually regaining strength. The syndrome was repeated one month later, and had again recurred on admission.

Fig. 4. Case 3: Multiple fungating hemorrhagic myosarcoma.

Physical Examination: Emaciation was prominent. The skin had a yellow tinge. Tenderness and muscular rigidity in the right lower quadrant were marked. The abdomen was distended. Hyperperistaltic bowel sounds were heard.

Roentgen Study: The colon was negative. The ileocecal valve was competent. (Roentgen examination elsewhere.)

Operation: An intussusception of the ileum, 3 inches in length, 5 feet proximal to the cecum, was found. The bowel above and below was negative.

Pathological Report: Multiple fungating hemorrhagic myosarcoma (Fig. 4).

CASE 4: A. V., white female aged 54, complained of vomiting, generalized pain and abdominal cramps, exaggerated bowel sounds, belching, and weight loss of three weeks duration. There was no hematemesis or blood in the stool. Constipation was intermittent.

Physical Examination: The abdomen was distended; peristaltic waves were visible, and bowel sounds were audible across the room.

Roentgen Examination: A scout film of the abdomen showed a small intestinal obstruction, with marked dilatation of the jejunum. The obstruction

Fig. 5. Case 4: Large polypoid submucous fibroma.

was located in the proximal ileum in the lower left iliac fossa. Two days following decompression of the bowel by a Miller-Abbott tube, the patient was up and about. Obstructive symptoms recurred two days after this, followed by exploratory laparotomy.

Operation: An intussusception including 12 inches of the proximal ileum was resected, with the mesentery and node-bearing area. On opening the bowel, a large polypoid submucous fibroma measuring 4.5 cm. in diameter was found.

Pathological Report: Large polypoid submucous fibroma of the small bowel (Fig. 5).

CASE 5: L. G., white female aged 45, complained of left flank pain, urinary frequency, and blood in the stool.

Past History: The patient had been hospitalized three times in the last two years at St. Luke's Hospital. The first admission, March 3, 1947, revealed hypertension with hemorrhage into the left eye, lower left quadrant pain extending into the groin posteriorly, blood in the stools of one month duration. Colon study suggested a polyp in the sigmoid, and re-examination was requested. A right nephrectomy was performed for a chronic pyelonephritis with a renal staghorn calculus.

Ten months later the patient underwent vaginal hysterectomy, colpoplasty, urethroplasty, and colpoperineoplasty for a heaviness in the lower abdomen,

Fig. 6. Case 5: Multiple carcinomas of small bowel.

urinary frequency of 16 months duration, and protrusion of the genital organs from the vagina for four months.

The third admission was four months later, for intermittent bouts of left upper back pain. Orthopedic studies were negative. X-ray examination of the colon was negative. Cystoscopy and pyelography were negative. A hemorrhoidectomy was done and a rectal fissure was excised.

On the present admission, April 17, 1949, attention was again focused on the urinary tract to account for hourly frequency. Retrograde pyelography, cystoscopy, and intravenous pyelography

were negative. Sigmoidoscopic examination was negative. Repeated colon studies suggested an irregular radiolucent area in the sigmoid.

Thirty-four days later, there were nausea, vomiting, and localization of pain in the lower left mid-abdomen. A roentgen study four days after this showed a negative esophagus, stomach, duodenum, and upper jejunum. There was no five-hour gastric residue and the barium had progressed into the transverse colon. The lower ileum was moderately dilated and areas of segmental spasm were present. The colon was negative.

Operation: At operation on June 9, 1949, multiple carcinoid tumors in the ileum, 2 feet proximal to the ileocecal valve, were found. There were metastatic nodes at the root of the mesentery. There were no palpable implants in the liver. The colon was negative.

Pathological Report: Multiple carcinoids of the small bowel; metastatic carcinoid of the regional mesenteric lymph nodes (Fig. 6).

METHODS OF EXAMINATION

Roentgen examination is the most decisive procedure which can be utilized in the actual diagnosis of a tumor of the small intestine. Generally speaking, no other method approaches it in accuracy of localization and differentiation. Weber and Kirklin reported an efficiency of 94 per cent in the duodenum, 85 per cent in the jejunum, and 67 per cent in the ileum in a series of 62 cases of small bowel tumors. The roentgen procedure should not be standardized but individualized in each case.

Since the initial complaints of most patients with small bowel tumors are those due to obstruction, the scout film in the recumbent and upright positions constitutes the preliminary examination. A positive diagnosis is often possible one or two hours after onset, and immediate decompression with a Miller-Abbott tube instituted. If decompression is accomplished, 60 c.c. of thin barium suspension may be administered through the tube proximal to the apparent obstruction, with frequent filming and fluoroscopy. The obstruction may be due to intussusception which requires immediate surgical intervention. However, intussusception may be of the releasing type, and between attacks a small bowel study is feasible. Extraluminal tumors give rise to obstruction relatively late, as a result of pressure or kinking of bowel loops. They are most often myomas, benign neurogenic tumors, cysts, and carcinoids. The largest group of tumors are those which grow inward or toward the lumen. These comprise most of the benign tumors, and symptoms of obstruction occur relatively early. This inward growth is also responsible for the next most common symptom, which is hemorrhage. (However, hemorrhage from the gastro-intestinal tract is usually from the stomach or colon.) Negative examinations with continuous demonstration of blood in the stools necessitate repeated studies of the small bowel, in an attempt to find the source of the bleeding. (The tumors most commonly found are hemangiomas, myomas, and neurogenic tumors.)

The pain is often periumbilical in location and may be due to ulceration of the tumor, with associated spasm and irritability of the intestine before either bleeding or obstruction has appeared. An extraluminal tumor has been known to become necrotic, cause localized peritonitis or a walled-off abscess as the first indication of the abdominal disease (Bockus).

The progressive meal or fractional study of the intestinal tract is carried out by administering the ordinary barium meal in the morning. Films are reviewed by the roentgenologist, and fluoroscopy is then carried out at thirty-minute intervals and further films are obtained until all the barium has left the small bowel (or the barium meal has reached the cecum). A disadvantage of this procedure is the intermittent emptying of barium from the stomach during the initial part of the examination. Also, overlapping of the loops of the upper small intestine may obliterate a lesion in a segment at the lower level. These disadvantages can be minimized by using a smaller amount of barium, as suggested by Golden.

In none of the cases in our series have we demonstrated a tumor by the small bowel enema popularized by Schatzki. We have used it only twice. Schatzki

recommends an uninterrupted flow of barium with a continuous and complete filling of the entire small intestine, as with a colon enema, using a Rehfuss or Miller-Abbott tube introduced into the duodenum. He lists as advantages the fact that the small intestine is seen filled in its entirety; that the actual filling of the small intestinal loops can be observed fluoroscopically; that the ileum is more evenly filled because the barium suspension is more fluid than is the opaque material in the ileum following oral ingestion; that the cecum and ascending colon can be better visualized; that the time required for the examination is shorter, with barium reaching the cecum in an average of fifteen minutes. The difficulties encountered are the annoyance of insertion of the duodenal tube and reflux of barium from the duodenum into the stomach, resulting in slow filling of the intestine, and a possibility of over-exposure even though the milliamperage is lowered.

Benign lesions of the small intestine are difficult to diagnose before obstruction has occurred. A large lesion involving one portion of the circumference of this thin-walled structure may be overshadowed by the flexibility and normal appearance of the uninvolved circumference. With a non-obstructing intraluminal lesion, a negative rounded or oval filling defect (subtraction of the normal lumen) can be expected. In the duodenum it is usually found. In the jejunum and ileum it must be sought for.

Large extraluminal growths are diagnosed late, only after they have reached sufficient size to cause obstruction by pressing against the wall of the intestine. The most frequent x-ray finding with benign tumors is intussusception, manifested either by a large intraluminal radiolucent defect produced by the intussuscepted loop, or by the passage of a small amount of barium through the narrowed lumen of the intussusception.

In the presence of a *malignant tumor* various degrees of filling defect and deformities such as are seen in tumors in other parts of the gastro-intestinal tract are demonstrated. The most common finding is annular constriction accompanied by dilatation of the proximal loop. Depending upon the point of origin and development of the tumor, there may be a marginal or central defect. The involved area is usually short, rigid, and fixed, with destruction or obliteration of the mucosal pattern. Åkerlund described peristalsis forming pseudo-diverticula and accordion-like pleating proximal to the tumor.

Complete obstruction may mask tumor characteristics, making the differential diagnosis impossible.

Roentgen findings in sarcomas are not characteristic. These lesions are more frequently multiple, cause less constriction, and are often longer than carcinomas.

Malignant tumors, like benign tumors, may cause intussusception.

SUMMARY

Sixteen cases of small intestinal tumors were found during operation and at autopsy in a ten-year period—1938 to 1948—at St. Luke's Hospital, Chicago. Twelve of these were malignant and 4 benign. Seven were located in the duodenum, 2 in the jejunum, and 5 in the ileum; 2 were multiple.

The most common symptoms of tumors of the small bowel are obstruction and melena.

Roentgen examination is probably the most important diagnostic procedure but still requires much more study before it approaches the efficiency it has attained in the diagnosis of lesions of the stomach and colon.

Five case histories are presented, including one of fibroma of the ileum. Only 42 examples of this tumor had been reported up to 1937.

Department of Radiology
St. Luke's Hospital
Chicago 5, Ill.

REFERENCES

1. BOCKUS, H. L.: Gastro-enterology. Philadelphia, W. B. Saunders Co., Vol. II, 1944, pp. 124–144.
2. BUCKSTEIN, J.: Clinical Roentgenology of the Alimentary Tract. Philadelphia, W. B. Saunders Co., 1940, pp. 9 and 359.

3. CAMERON, A. L.: Primary Malignancy of the Jejunum and Ileum. Ann. Surg. **108:** 203–220, 1938.
4. DOUB, H. P.: Malignant Tumors of the Small Intestine. Radiology **49:** 441–451, November 1947.
5. FICARRA, B. J., AND MARSHALL, S. F.: Primary Carcinoma of the Jejunum. S. Clin. North America **25:** 713–718, 1945.
6. FRANK, L. W., MILLER, A. J., AND BELL, J. C.: Sarcoma of the Small Intestine; Report of Four Cases. Ann Surg. **115:** 544–565, 1942.
7. FRASER, K.: Malignant Tumors of the Small Intestine: A Review of the Literature and Report of 21 Cases. Brit. J. Surg. **32:** 479–491, 1945.
8. GOLDEN, Ross: Radiologic Examination of the Small Intestine. Philadelphia, J. B. Lippincott Co., 1945.
9. HOFFMAN, W. J., AND PACK, G. T.: Cancer of the Duodenum; Clinical and Roentgenographic Study of 18 Cases. Arch. Surg. **35:** 11–63, 1937.
10. HUMPHREYS, E. M.: Carcinoid Tumors of the Small Intestine: A Report of 3 Cases with Metastasis. Am. J. Cancer **22:** 765–775, 1934.
11. LEWIS, D. L.: Two Cases of Sarcoma of the Small Intestine with Unusual Features. Brit. J. Surg. **26:** 540–546, 1939.
12. MATEER, J. G., AND HARTMAN, F. W.: Primary Carcinoma of the Duodenum. J. A. M. A. **99:** 1853–1859, 1932.
13. MAYO, C. W.: Malignancy of the Small Intestine. West. J. Surg. **48:** 403–407, 1940.
14. PENNINGTON, R. E., AND PRIESTLEY, J. T.: Multiple Carcinoid Tumors of the Small Intestine: Proc. Staff Meet., Mayo Clinic **18:** 49–51, 1943.
15. RAIFORD, T. S.: Tumors of the Small Intestine. Arch. Surg. **25:** 122–177 and 321–355, 1932.
16. RANKIN, F. W., AND NEWELL, C. E.: Benign Tumors of the Small Intestine: Report of 24 Cases. Surg., Gynec. & Obst. **57:** 501–507, 1933.
17. SCHATZKI, R.: Small Intestinal Enema. Am. J. Roentgenol. **50:** 743–750, 1943.
18. SHALLOW, T. A., EGER, S. A., AND CARTY, J. B.: Primary Malignant Disease of the Small Intestine. Am. J. Surg. **69:** 372–383, 1945.
19. WEBER, H. M., AND KIRKLIN, B. R.: Roentgenologic Manifestations of Tumors of the Small Intestine. Am. J. Roentgenol. **47:** 243–253, 1642.

SUMARIO

Tumores Primarios del Intestino Delgado

En un decenio (1938 a 1948), encontráronse 16 casos de tumores del intestino delgado durante la operación o la autopsia en el Hospital St. Luke de Chicago. Doce fueron malignos y 4 benignos. Siete estaban localizados en el duodeno, 2 en el yeyuno y 5 en el ileon; 2 eran múltiples.

Los síntomas más comunes de los tumores del intestino delgado consisten en oclusión y melena. El examen roentgenológico constituye probablemente el más importante procedimiento diagnóstico, pero exige todavía estudio mucho mayor antes de que su eficiencia se aproxime a la alcanzada en el diagnóstico de las lesiones del estómago y el colon.

En los tumores benignos, el hallazgo más frecuente es invaginación traducida ya por la presencia de una gran deformidad intraluminal radioluciente producida por el asa invaginada o por el pase de una pequeña cantidad de bario a través de la estrechada luz de la invaginación. En los tumores malignos, obsérvanse nichos de varios grados, siendo el hallazgo más común contracción anular acompañada de dilatación del asa proximal. La zona afectada suele mostrarse acortada, rígida y fija, con destrucción u obliteración del molde de la muscosa.

Preséntanse cinco historias clínicas, incluso una de fibroma del ileon. Hasta 1937 sólo se habían comunicado 42 casos del último.

General Considerations in the Roentgen Examination of the Colon[1]

JOSEPH C. BELL, M.D

Louisville, Ky.

THE ROENTGEN examination of the colon, including the rectum, if properly done and if conditions present are accurately demonstrated, interpreted, and evaluated, is one of the most difficult—probably the most difficult—of all radiologic examinations. Even so, it is the most widely used and accurate single method employed in definitive diagnosis of colonic disease. It demands skill, experience, wisdom, and judgment in interpretation, painstaking roentgenoscopic observation during filling, detailed care in the radiographic phase of the examination, and more than the average amount of hard work.

That the examination be thorough, and so planned and executed that any abnormality demonstrable by the roentgen ray will be detected, is of utmost importance, for the large bowel may be the site of many diseases. Not a small percentage of these can be eradicated or effectively controlled if discovered and accurately diagnosed, especially when recognized in a relatively early stage. Many bowel disturbances are entirely functional, but even in these the roentgen examination is essential for ruling out organic causes for the patient's complaints.

Cancer is foremost in the minds not only of the medical profession but of the laity as well. Approximately 17 per cent of all deaths caused by cancer are traceable to the colon and rectum, and of these approximately 75 per cent are the result of disease of the rectum, the rectosigmoid, and the sigmoid. Polyps have approximately the same percentage incidence as cancer in the various parts of the large bowel, and are always potential sites of malignant growth. The importance of their early detection and adequate therapy cannot be too strongly emphasized.

Diverticulosis of the colon is a relatively common finding in mid and late adult life. In itself it may not be serious except when infection and inflammation of one or more of the diverticula supervene, giving rise to an acute diverticulitis which, in turn, may be followed by a pericolonic abscess and at times perforation into the peritoneal cavity. The pericolonic inflammatory reaction causes narrowing of the adjacent lumen of the bowel and may result in a high degree of partial or even a complete obstruction. The deformity seen in acute diverticulitis may closely simulate that due to carcinoma, and from the radiological standpoint the differential diagnosis, in a few instances, may be most difficult. Diverticulosis and cancer are infrequently encountered in the same individual, and concurrent diverticulitis and cancer are rare indeed. This is fortunate not only for the patient but for the examiner as well, for an accurate differential diagnosis may be impossible in the latter instance.

No attempt will be made to consider, even briefly, the many lesions with primary manifestations in the colon, for they are generally recognized. Amebic colitis, however, justifies mention, for an amebic granuloma may closely simulate a carcinoma, although in our experience such lesions, as well as all others demonstrable distal to the cecum, have been accompanied by deformities of the cecum, which in themselves have been sufficiently characteristic to justify a strongly presumptive diagnosis of amebiasis.

Accurate diagnosis of colonic disease is a cooperative and not an individual enter-

[1] Presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

prise. A detailed and intelligently taken history and a painstaking physical examination, always including a digital rectal investigation, are essential. Since a high percentage of colonic lesions manifest themselves in the rectum, the rectosigmoid, or proximal part of the sigmoid, areas readily explored by an adequate sigmoidoscopic examination, proctosigmoidoscopy should, when at all feasible, be routine. Regardless of the information acquired by other methods, a thorough roentgen examination of the entire colon and rectum is indicated in almost all cases, for many lesions may be multiple and others may involve various parts or all of the bowel.

We have emphasized the difficulties encountered in the roentgen examination of the colon and rectum. The causes are many. The colon is a long tube-like structure with three major flexures, the hepatic, the splenic, and the sigmoid. Even these are far from constant in form and position, and there are many secondary flexures and areas of angulation of varying degrees. Shadows of adjacent loops are frequently superimposed and may be most difficult to separate even by properly directed rotation of the patient and most careful palpation. This is particularly true of the sigmoid, especially when it is long and redundant. Skill in manipulation and painstaking care, however, will make possible the roentgen demonstration of almost all abnormalities.

The colon functions as a retention basin for the waste products of ingested material. Thorough elimination of these products and cleansing of the bowel are essential preliminaries to the roentgen examination. We consider castor oil to be the most effective cleansing agent, but in a few instances, even in adequate dosage, it may fail and repeated dosage, with a residue-free diet, may be required. This is emphasized, for fecal masses may exactly simulate some organic lesions, especially polyps.

The bowel itself may constitute a major problem in an adequate investigation, particularly when highly irritable. Contraction waves may make retrograde filling most difficult, and a persistent contraction ring may closely simulate an annular carcinoma. Gentle manipulation and slow injection usually will overcome these difficulties. At times, however, it may be necessary to permit the patient to expel the injected material, after which a second attempt may prove successful. In a few instances, re-examination may have to be delayed for twenty-four hours.

A major difficulty often lies with the patient, who may be tense, apprehensive, or emotional. This may be overcome by a few words of encouragement from the examining physician. We find encouragement and gentle manipulation always of great value throughout filling of the bowel.

The time required for the examination constitutes another difficulty to be considered. The investigation must be thorough, unhurried, but done with dispatch. Each segment of the bowel must be carefully observed fluoroscopically during filling, both with and without compression. If the examiner is satisfied that filling is normal, other segments in turn are investigated, purposeless re-examination being avoided. Compression is essential, for some narrow annular lesions may become evident only when the margins are separated.

Any abnormality in filling should immediately be recorded on films, serial films being most valuable when differential diagnosis is a consideration. If filling is unsatisfactory or the findings are questionable, re-examination at the earliest time feasible, is essential.

COMMENT

The roentgen examination of the colon and rectum is difficult and time-consuming and will tax the skill and ingenuity of the most competent examiner. Potential sources of error in diagnosis are many, but when full use of indicated methods of investigation is made, diagnostic inaccuracies will be rare.

402 Heyburn Bldg.
Louisville 2, Ky.

SUMARIO

Consideraciones Generales en el Examen Roentgenográfico del Colon

El examen roentgenológico del colon y el recto resulta difícil y largo, poniendo a prueba la destreza del examinador más competente, pero reviste la mayor importancia, dado que el intestino grueso puede ser asiento de muchas dolencias. La causas potenciales de error son numerosas, pero utilizando en pleno todos los métodos de investigación indicados, los errores de diagnóstico deben ser raros. Entre los factores esenciales en el estudio roentgenológico figuran la limpieza previa del intestino, la manipulación suave y la inyección lenta para dominar las contracciones e infundir aliento al enfermo nervioso y aprensivo durante la exploración. Hay que observar con cuidado fluoroscópicamente cada segmento del intestino, tanto con como sin compresión, y que registrar inmediatamente en radiografías toda anomalía observada en el henchimiento, siendo las radiografías seriadas las más útiles en toda ocasión en que se trate del diagnóstico diferencial.

DISCUSSION

(Papers by Jenkinson, Pfisterer and Seitz; Bell; Moreton[1])

L. Henry Garland, M.D. (San Francisco, Calif.): My remarks will be directed chiefly to the papers concerned with the colon, though in passing I wish to comment on Dr. Jenkinson's method of examining the small bowel. In our practice we use a cold-water barium mixture. I should like to ask Dr. Jenkinson his opinion about a small drink of this kind. We have not used colloidal barium or saline "chasers" and wonder if he has had any experience with these.

One hears of tumors arising in Meckel's diverticulum, but personally I have seen none. Has Dr. Jenkinson seen a case?

Now as to the colon: The most important considerations in the x-ray examination of the colon were well emphasized by Dr. Bell and Dr. Moreton—skill, experience, and hard work. To these they add unlimited patience. To identify the significance and nature of areas of apparent organic narrowing one must, in a minority of patients, refill the colon once or twice on the day of first examination, or refill it later in the same week. We specify the element of time because, if the patient with early, localized curable cancer gets away with an admonition "to come back in a few weeks," the latter often stretch out to fatal months.

The reassuring word, plus gentle filling at the first part of the enema, are added factors of major importance. The repeat examination within a week is often essential.

A big problem, it seems to me, is "What should we do today with the patient strongly suspected of polyps?" First, we are all pretty well agreed on the desirability of adequate preparatory bowel cleansing with castor oil, plus abstention from food on the morning of examination. Second, we agree that the distal one-third of the colon (the area of high yield) should be studied with extra care during filling and after evacuation. But the big problem is: Shall we attempt the initial colon roentgen study plus the double contrast examination for polyps at the same sitting, or shall we defer the double-contrast study till next day, because sure demonstration of the cecum often entails terminal ileum filling, and a filled ileum often confuses or obscures the double-contrast study?

Considerations of time, peace of mind, and convenience render it desirable that as much as possible be done at one examination visit. Therefore it seems to me that one might reasonably have this program (which I submit to the essayists as a question): (*a*) If polyps are visible or strongly suspected at the initial part of the barium enema study, then fill the colon only to about the mid transverse. Make your small and large films. Allow the patient to evacuate. Make your post-evacuation records. Fill with air and complete the study after that maneuver. Yes, I realize that the cecum may not be completely filled at first, but in most cases filling will be adequate after evacuation or air injection. (And manual examination at time of surgical removal of the polyps in the distal colon will permit checking the cecal area.) (*b*) If polyps in the common site are not shown at time of filling, the whole colon should be filled. If the terminal ileum barium is not extensive, then the double-contrast study may be proceeded with. If the ileal filling is extensive, then the patient must be asked to return on a succeeding day for double-contrast study (at which time only distal colon barium filling is desirable).

[1] "Double-Contrast Examination of the Colon," not submitted for publication.

When is double-contrast examination indicated? Dr. Moreton would use it as "an ideal routine study" in all cases. Yet he admits its major usefulness is in the demonstration of small polyps, a lesion reported by Smedal to occur in as low as 2 per cent of persons at autopsy, and reported to be found by Scarborough in about 5 per cent of living persons. Must one put 95 to 98 patients to the discomfort, expense and hazard of double-contrast studies for the sake of the other 2 to 5? We doubt that the answer is "yes." True, the incidence of polyps increases with age, with a history of unexplained bleeding, and with the finding of a rectal polyp. Nevertheless, it is our impression that double-contrast studies are *indicated* in only about 10 per cent of persons coming to the average radiologist for colon examination.

Both essayists are to be complimented on their excellent roentgenographic technic, and on stressing the fact that we must not be satisfied with finding one lesion in a colon: many persons have multiple, distinct colon lesions which a consultant radiologist should demonstrate.

Dr. Jenkinson (*closing*): We have used the cold-water mixture in doing some of our small bowel studies, but I do not believe we have gained much additional information from its use. I think Dr. Garland has a point, though, that small amounts of barium suspension are advantageous. We have occasionally used the saline preparation in our work and I believe in some instances, it has been advantageous.

Regarding tumors of Meckel's diverticulum: In going over the literature, Dr. Pfisterer, Dr. Seitz, and I have not found a reported case. We did not include in this series any of the tumors that involved the ampulla of Vater. I think it should be stressed here that tumors of the small bowel, so far as we know from reviews of thousands of autopsies and operations, are not very common.

It is true that our methods of examining the small bowel are not as efficient and thorough as studies of the colon and stomach. If we are to find these tumors of the small bowel, we must be very thorough and painstaking, and it is often necessary to do frequent examinations. In other words, we must strive to be as accurate in small bowel studies as in studies of the stomach or duodenum.

There are no roentgen findings at this time known to be pathognomonic for carcinoma of the small bowel. I think if we can demonstrate a lesion, we are doing all that can be expected.

High Renal Ectopia and Congenital Diaphragmatic Hernia[1]

FELIX G. FLEISCHNER, M.D., SAMUEL A. ROBINS, M.D., and MORRIS ABRAMS, M.D

Boston, Mass.

ANOMALIES OF the position of the kidneys are not infrequent. Ectopic kidneys usually are found in the pelvis, the iliac or low lumbar region; high ectopia, in which the kidney lies in the thorax, is a rarity.

Gruber (3) in 1927 had collected from the literature 11 cases of partial or complete thoracic ectopia of the kidney observed exclusively in fetuses or stillborn children; in 2 the anomaly was on the right, in the others on the left side. Kleine (6) in 1928 added a case of thoracic ectopia of the left adrenal and upper pole of the kidney in a newborn female, and Campbell (2) in 1930 found most of the left kidney protruding through a large defect in the diaphragm, in a one-year-old male child who died of marasmus. In many instances other malformations, particularly thoracic displacement of other abdominal viscera, were also present.[2]

CASE REPORT

E. Z., a 65-year-old woman, was first seen in 1942 because of severe upper quadrant pain and jaundice. No opaque gallstones were visible. The gallbladder could not be demonstrated by cholecystography. Roentgen examination of the chest revealed a hemispherical soft-tissue mass protruding above and apparently resting upon the right diaphragm in the posterior medial portion. It was 6 cm. in diameter. The diaphragm showed a normal descent on deep inspiration, while the protruding mass seemed to follow the slight upward movement of the lower ribs. The findings were interpreted as indicating diaphragmatic hernia or, less probably, a tumor of unknown nature (Fig. 1). No further investigation was undertaken.

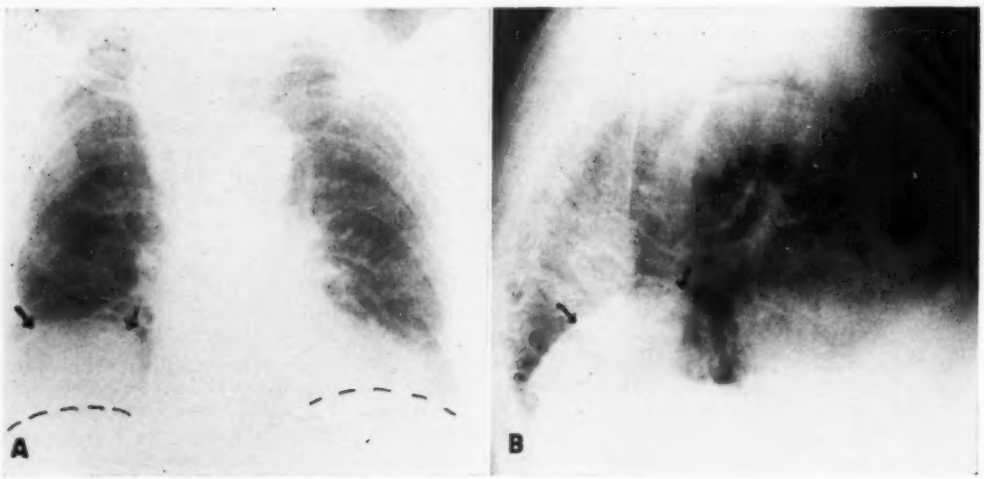


Fig. 1. Postero-anterior (A) and right lateral (B) views of the chest. The interrupted lines mark the diaphragm; the arrows the supradiaphragmatic mass.

---

[1] From the Department of Radiology, Beth Israel Hospital, and Harvard Medical School, Boston, Mass. Accepted for publication in July 1949.

[2] Since the submission of this paper two publications concerning the same subject have appeared: High Renal Ectopy: a Case Report, by R. J. Spillane and George C. Prather, J. Urol. **62:** 441, October 1949, and Diaphragmatic Herniation of the Kidney, by R. G. Williams and A. J. Tillinghast, Radiology **53:** 566, October 1949. Both deal with left-sided ectopy.

The patient was seen repeatedly in the Out-Patient Department and the previous findings were confirmed. She was readmitted in April 1947 because of another severe attack of epigastric and right upper quadrant pain with jaundice. The icteric index varied from 8 to 54. The patient also had asthma and angina pectoris.

Intravenous urography identified the herniated mass as the right kidney. The upper pole lay at the level of the upper edge of the 10th thoracic vertebra, the lower pole at the level of the upper edge of the 3rd lumbar vertebra. The lateral view revealed the kidney lying on the posterior portion of the diaphragm close to the posterior chest wall. The calyces and pelvis were normally outlined (Fig. 2). The left kidney was low in position, the lower pole being about 3.5 cm. below the iliac crest. Other than the abnormally high position of the right kidney, there was no evidence of gross abnormality of the upper urinary tract. Examination of the stomach revealed a small hiatus hernia, with reflux of gastric content into the esophagus.

Cholecystectomy for chronic cholecystitis and cholelithiasis was performed. During the operation, the right kidney could not be felt in its normal position. No attempt was made to examine the ectopic kidney and the right diaphragm. The patient recovered uneventfully and was reported in fair health a year later.

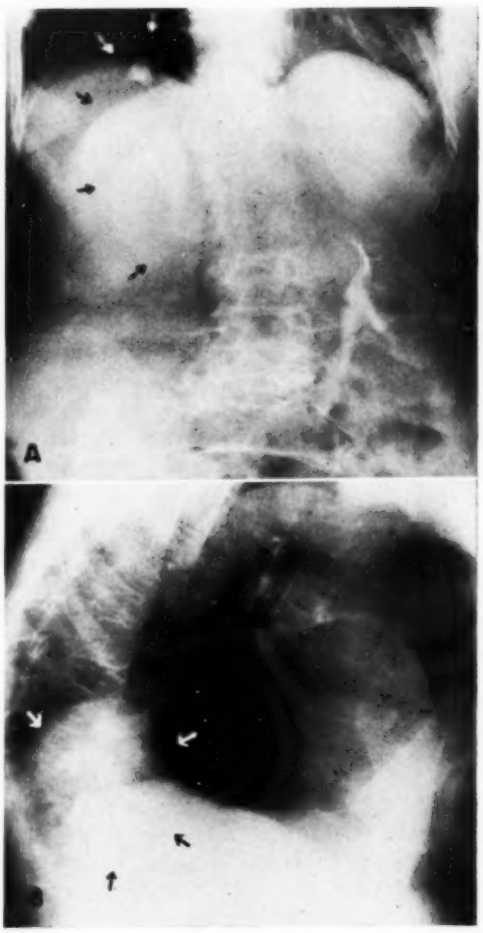


Fig. 2. Intravenous urography, anteroposterior (A) and right lateral (B) views. The arrows mark the contours of the right kidney identified as such by the dye-filled calyceal system.

COMMENT

According to the literature, high renal ectopy is rare, particularly on the right side, and so far as we know, it has not previously been identified during life.

The term diaphragmatic hernia comprises two essentially different conditions, which for the most part are not distinguishable clinically. In the true hernia, a portion of the diaphragm made up of its structural elements, muscle, pleura, and peritoneum, or pleura and peritoneum alone, protrudes into the thorax and contains the eventrated abdominal viscera. In false hernias, traumatic and congenital, there is a hole in the diaphragm, a rent or developmental defect, respectively, through which the abdominal viscera prolapse into the chest. High renal ectopia apparently is connected with a congenital defect. Formation of the diaphragm is a complicated procedure involving a long series of developmental processes of diverse nature. Projections and shelves arise from the ventral, lateral, and dorsal walls of the primordial celomic cavity to separate the pericardial and pleural cavities from the peritoneal cavity. This membranous diaphragm is later reinforced by the diaphragmatic muscle peeled from the body wall (1). Wherever the various parts meet, irregularities and disturbances in the process of fusion may occur. These are the sites of the commonly encountered congenital diaphragmatic defects and also of acquired hernias due to weakness of the diaphragmatic plate at the sites of fusion.

While defective fusion is generally considered the primary disturbance in congenital defects of the diaphragm, and the

prolapse of abdominal viscera secondary, in the case of renal ectopia another causal sequence is possible. The formation of the dorsal paravertebral portion of the diaphragm is closely related to the wolffian body, mesonephros, and the adrenal, which forms a large bulge in the early fetus. The final closure occurs just above and medial to the large adrenal gland, in the posteromedial portion at the trigonum lumbocostale, also called the foramen of Bochdalek. If the involution of the upper portion of the mesonephros were disturbed or the caudal migration of mesonephros and adrenal delayed, closure of the diaphragm would be prevented. In this instance the ectopic kidney would not have slipped through a hole in the diaphragm but would have been responsible for its imperfect formation.

The roentgenologic appearance of the ectopic kidney in our patient does not differ from that of other congenital hernias of the same localization, either true or false (4, 5, 7). A hemispherical soft-tissue mass protrudes above the diaphragm in its posterior medial portion and appears to rest upon it with a broad base. The content of hernias of this location can occasionally be recognized as a portion of the gastro-intestinal tract, such as stomach or colon, when it contains gas or fills with barium. On the right side, however, the hernia more often contains liver or omentum, structures which cannot ordinarily be identified. The kidney can easily be demonstrated by intravenous urography.

The ectopia of the kidney in the case reported here had no apparent clinical significance. It was an incidental finding in an elderly woman. All previously reported cases of thoracic renal ectopia were in stillborn fetuses or short-lived children. This is apparently attributable to the fact that this anomaly occurred as a part of other more extensive and more serious malformations. In the present case the longevity of the patient and the absence of clinical signs and symptoms suggest that the renal ectopia was an isolated developmental error without serious consequence.

SUMMARY

The observation of a thoracic ectopia of the right kidney in an elderly women is reported. It presented itself, like other congenital hernias, in the posterior medial portion of the diaphragm, in the region of the trigonum lumbocostale or "foramen of Bochdalek." The content of the hernia was identified as kidney by intravenous urography. There were no clinical signs or symptoms referable to the anomaly.

Previous observations of thoracic ectopia and its genesis are discussed. This seems to be the first instance in which the diagnosis was made during life.

330 Brookline Ave.
Boston 15, Mass.

REFERENCES

1. BREMER, J. L.: The Diaphragm and Diaphragmatic Hernia. Arch. Path. **36:** 539–549, 1943.
2. CAMPBELL, M. F.: Renal Ectopy. J. Urol. **24:** 187–198, 1930.
3. GRUBER, G. B., in Schwalbe-Gruber: Morphologie der Missbildungen d. Menschen und d. Tiere. Part III, Div. 3, Chapter 2, 1927.
4. HARRINGTON, S. W.: Various Types of Diaphragmatic Hernia Treated Surgically. Report of 430 Cases. Surg., Gynec., & Obst. **86:** 735–755, 1948.
5. KIRKLIN, B. R., AND HODGSON, J. R.: Roentgenologic Characteristics of Diaphragmatic Hernia. Am. J. Roentgenol. **58:** 77–101, 1947.
6. KLEINE, H. O.: Die Bedeutung der intrathorakalen Nierendystopie für die Entstehung kongenitaler Zwerchfellücken. Beitr. z. path. Anat. und z. allg. Path. **80:** 609–621, 1928.
7. MARKS, J. H.: Diaphragmatic Hernia. Am. J. Surg. **54:** 306–316, 1941.

SUMARIO

Ectopia Renal Alta Congénita

Preséntase una observación de ectopia torácica del riñón derecho en una anciana. Ocurrió en la porción media posterior del diafragma, en la región del trígono lumbocostal o "agujero de Bochdalek." El contenido de la hernia fué identificado como riñón por la urografía intravenosa. No había signos clínicos ni síntomas imputables a la anomalía.

Este caso parece ser el primero en que se hiciera el diagnóstico de ectopia renal alta durante la vida.

High-Voltage Technic in the Diagnosis of Polypoid Growths of the Colon[1]

CESARE GIANTURCO, M.D.
Urbana, Ill.

ALL RADIOLOGISTS realize the limitations of a fully opaque barium enema for the demonstration of polypoid growths of the colon. This realization has stimulated the use of double-contrast studies (Fischer, Weber), spot films with compression, the study of the mucosal appearance after evacuation (Berg, Forssell) and the use of semitransparent media (Ledoux-Lebard and Garcia-Calderon). All these technics involve a considerable amount of labor on the part of the patient and of the doctor, and each of them has its own inherent limitations.

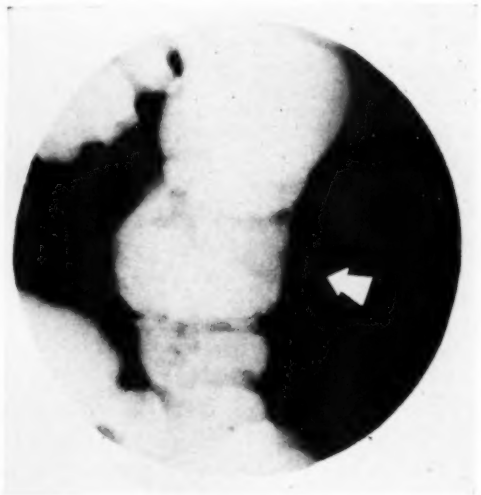


Fig. 1. Fecal material.

Fig. 2. Air bubbles.

A double-contrast study of the colon is indeed a beautiful and brilliant procedure when successful, but too often the heavy barium mixture collects in pools which show no double contrast or dries in scales when the water has been absorbed too thoroughly by the thirsty mucosa of the colon.

The mucosal study after evacuation of the enema can be confusing. One should, of course, be familiar with the mucosal pattern of the colon, but one must realize how strange it would seem if, when looking for an ink spot on a piece of cloth, we should wrinkle the cloth instead of stretching it flat.

Compression films are useful, but the colon is a long organ and one cannot study all of it by this means; the flexures, the rectum, and the sigmoid cannot be compressed because of their deep location.

Semitransparent media were used by Ledoux-Lebard and Garcia-Calderon because polypoid growths are shown as radiolucent defects on the films. These media, however, are expensive (one must use thorium because thin barium suspensions are deposited too rapidly) and give very poor fluoroscopic images. A semitransparent study must be supplemented

[1] From the Carle Hospital Clinic, Urbana, Ill. Accepted for publication in July 1949.

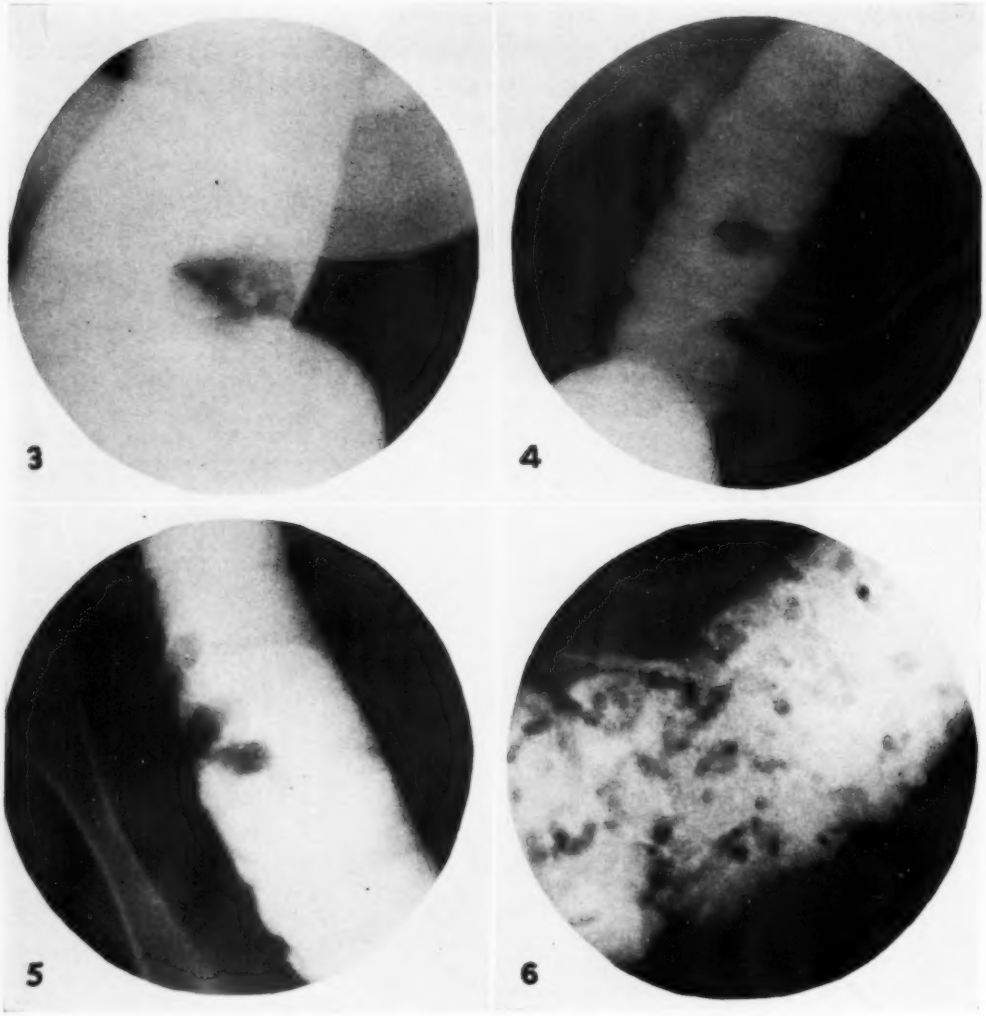


Fig. 3. Single polyp 2 cm. in diameter at rectosigmoid junction.
Fig. 4. Single polyp 4 mm. in diameter at sigmoid.
Fig. 5. Three polyps, 5 mm. in diameter each, at descending portion.
Fig. 6. Multiple polypi in transverse colon, varying in diameter from 1 to 3 mm., following severe amebic colitis.

by a second enema of fully opaque barium for the fluoroscopy.

In 1936, Rigler and Eriksen advocated the use of over-exposed films for the demonstration of polypoid growths of the stomach. Independently, and a few months later, I began to study the possibilities of the "over-exposure" or high-voltage technic in the examination of the colon. This technic is based on the observation that radiographic opacity changes with the voltage employed. Thus, a barium mixture which is fully opaque at fluoroscopy can be made more and more transparent by increasing the voltage for radiography. This means that the depth of the colon, as well as its surface, can be made visible, just as we see the trabeculation of bone or transparent stones in the gallbladder.

The first thing to be done was to find the minimum amount of barium necessary in a susqension which would be fully opaque at

fluoroscopy. One part of barium powder to four parts of water by volume gave a mixture which was fluoroscopically opaque. The radiographic voltage necessary to penetrate this mixture is well within the range of most modern machines. We use 100 kv., 300 ma., 1/8 to 3/8 sec., Bucky, 36 inches distance, par speed screen. With these factors, we can see one loop of the colon through another loop, and radiolucent areas become readily visible.

Radiolucent areas can be caused by polypoid growths, by air bubbles, and by fecal material. We prepare all our patients with 2 ounces of castor oil, but the high-voltage technic is so sensitive that it makes one realize the shortcomings of the most thorough preparation. Since radiolucent areas do not always represent polyps, we take, as a routine, three 14 × 17-inch films, one supine left oblique centered to show the rectum and the sigmoid loop, one supine right oblique, and one prone. This gives multiple checks on doubtful shadows. These large films should be carefully studied, but their interpretation is not difficult. Fecal material (Fig. 1) is mottled and irregular. Air bubbles (Fig. 2) tend to be multiple, round, or oval, changing shape and position in the different films. Polypoid growths (Figs. 3–6) can be of any shape but are never of mottled appearance and their shape and position remain essentially unchanged in the various views.

Should there still be doubt as to the nature of a radiolucent shadow, a re-examination after the evacuation of the first enema will settle the question, since air and fecal material will be expelled or substantially moved along the colon.

The high-voltage technic is useful not only in the diagnosis of polypoid growths of the colon but other lesions are visualized by it a little more thoroughly than with other methods. We have used this procedure as a routine for the past twelve years.

Since the mixture of barium and water is the same as that used by most workers, the only change advocated is the increase in exposure, possibly through increase in voltage, so as to obtain soft gray instead of the black and white films which show so little of the inside of the colon. It is quite possible that even better radiographic results will be obtained with the new units capable of operating at 120–130 kv.

In order to avoid sedimentation of barium, fluoroscopy must be carried out rapidly and systematically, and the rate of flow kept fairly fast.

Carle Hospital Clinic
Urbana, Ill.

REFERENCES

1. BERG, H. H.: Röntgenuntersuchungen am Innenrelief des Verdauungskanals. Leipzig, Georg Thieme, 2nd Ed., 1931.
2. FISCHER, A. W.: Über die Röntgenuntersuchung des Dickdarms mit Hilfe einer Kombination von Lufteinblasung und Kontrasteinlauf (kombinierte Methode). Arch. f. klin. Chir. **134:** 209–269, 1925.
3. GIANTURCO, C.: Comparative Value of Various Methods in the Roentgenologic Examination of the Colon. Illinois M. J. **71:** 67–74, 1937.
4. LEDOUX-LEBARD, R., AND GARCIA-CALDERON, J.: Les techniques d'examen de la muqueuse du gros intestin. J. de radiol. et d'électrol. **17:** 429–466, 1933.
5. RIGLER, LEO G. AND ERIKSEN, LESTER G.: Benign Tumors of the Stomach: Their Incidence and Malignant Degeneration. Radiology **26:** 6–15, 1936.
6. WEBER, H. M.: Carcinoma of the Colon:—Its Roentgenologic Manifestations and Differential Diagnosis. Am. J. Cancer **17:** 321–341, 1933.

SUMARIO

La Técnica de Alto Voltaje en el Diagnóstico de los Tumores Polipoideos del Colon

La técnica descrita para el diagnóstico de los tumores polipoideos del colon está basada en el hecho de que, acrecentando el voltaje radiográfico, puede aumentarse cada vez más la transparencia de una mezcla de bario de suficiente opacidad para observación roentgenoscópica. Con los siguientes factores, es posible ver un asa de colon a través de otra y visualizar zonas radiolucientes: 100 kv., 300 ma., 1/8 a 3/8 de segundo, diafragma de Bucky, 90 cm. de distancia.

Las zonas radiolucientes pueden proceder de tumores polipoideos, burbujas de aire o materias fecales, pero la diferenciación no debe resultar difícil con radiografías tomadas en las posiciones oblicua izquierda supina, oblicua derecha supina y prona.

Acromioclavicular Changes in Primary and Secondary Hyperparathyroidism[1]

LOUIS NATHANSON, M.D., F.A.C.R., and MORRIS SLOBODKIN, M.D.

Brooklyn, N. Y.

THE DESCRIPTION of a roentgenologic finding as a presumptive sign is always a matter of general interest, and while no claim of infallibility is made for our observation, we have decided to report it in the hope that it will be checked and commented upon by other workers. We have observed this finding in several cases of hyperparathyroidism, both of the primary type and of the secondary type associated with chronic renal insufficiency (renal rickets, renal osteodystrophy, or osteonephropathy). In one case the observation of the sign in a routine chest film suggested the diagnosis to one of us (L. N.), and this was later confirmed by a roentgen survey of the skeletal system, biochemical analysis of the blood, and by the postmortem finding of a parathyroid adenoma.

The bone findings in primary hyperparathyroidism (osteitis fibrosa cystica generalisata) and renal osteodystrophy (or renal rickets, as it is called in the older literature) have been adequately described elsewhere (3, 6, 13, and 14), and it is not our purpose to review them here except as they appear in our cases. We wish merely to call attention to changes which we have observed in the acromioclavicular articulations in these cases, consisting of cupping of the outer end of the clavicle, with fraying due to irregular absorption of the articular surface. Similar though less striking changes may be present in the articular surface of the acromion process, and there may or may not be widening of the acromioclavicular joint space.

Although we have never observed an epiphysis in the outer end of the clavicle, nor have we seen one described, the changes simulate the metaphyseal cupping, fraying, and decalcification seen in vitamin D-deficiency rickets. The reason for the localization of these changes is not apparent, but presumably it is related to the activity of the shoulder and its associated joints. Grant (8) has described the motions about the acromioclavicular joint with movement of the scapula, and Oppenheimer (12) has demonstrated roentgenographically that there is motion in the acromioclavicular joint during all movements of the arm except pronation and supination. The latter writer stresses the importance of the joint function, stating that the mobility of the arm depends significantly on the mobility of the scapula, and that the mobility of the scapula in turn depends on the mobility of the shoulder girdle in the sternoclavicular and acromioclavicular joints.

The following cases illustrate the changes described as they appear in the various types of hyperparathyroidism. The first case is one of renal osteodystrophy in association with congenital bladder neck obstruction leading to marked bilateral hydronephrosis and hydroureters, with severe impairment of renal function.

CASE 1: A white male, aged 16 years, was found to have had a congenital urinary defect at the age of five years, when he was investigated for polyuria and enuresis. A diagnosis of congenital polycystic kidneys had been made elsewhere. On admission, the patient appeared stunted in growth and chronically ill, with relatively long upper extremities and a large chest diameter. Physical examination was essentially negative except for bilateral lumbar masses and the presence of a distended bladder reaching to the umbilicus. Blood chemistry studies revealed a urea nitrogen level of 175 mg. per cent, creatinine 7 mg. per cent, and uric acid 6.6 mg. per cent.

Cystoscopy showed a definite contracture of the vesical neck, with induration in the posterior urethra. The bladder contained 40 ounces of cloudy urine. The ureteral orifices were of the golf-hole

[1] From the Departments of Radiology, The Maimonides Hospital, Israel Zion Division, and the Jewish Sanitarium and Hospital for Chronic Disease, Brooklyn, N. Y. Accepted for publication in July 1949.

type, and an attempt at catheterization was unsuccessful owing to buckling of the catheters in the dilated, tortuous ureters. However, 24 ounces of 3 per cent sodium iodide were instilled into the bladder for cystographic examination, and marked bilateral hydronephrosis and hydroureters were demonstrated by reflux of the dye (Fig. 1).

Roentgen examination revealed a slight degree of stippled rarefaction of the skull bones and slight generalized osteoporosis of the long bones and spine. The shoulder (Fig. 2) showed cupping and widening,

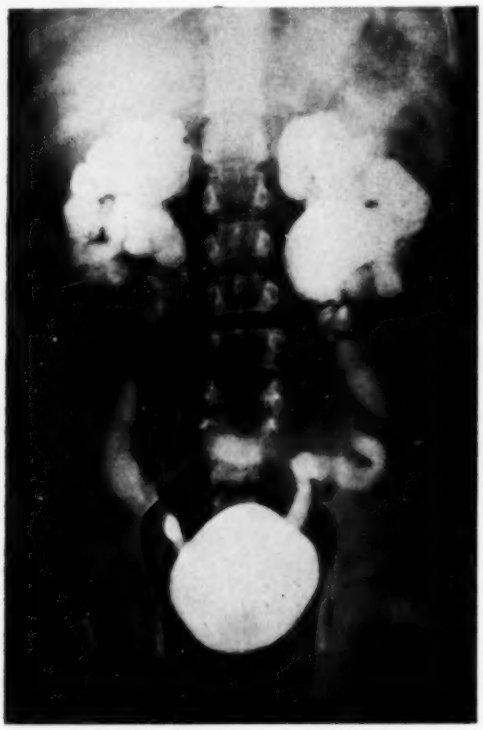


Fig. 1. Case 1. Retrograde study of the urinary tract produced by reflux following the introduction of 24 ounces of 3 per cent sodium iodide solution for cystography. Advanced bilateral hydroureters and hydronephrosis, with dilatation of the bladder, caused by congenital stenosis of the bladder neck.

decalcification, and fraying of the outer end of the clavicle, with widening of the acromioclavicular joint space. There was also widening of the epiphyseal cartilage at the upper end of the humeral shaft, with irregular decalcification of the adjacent metaphysis. Similar changes were noted in the hips and the lower ends of both tibias. In the hips (Fig. 3) there were widening of the epiphyseal cartilages and irregular rarefaction of the metaphyses, with a moderate degree of slipping of the femoral necks upward on the heads.

Following cystostomy, which was performed because of urinary retention, the patient's condition became progressively worse. He died thirteen days after operation, in severe uremia. Postmortem examination revealed congenital stenosis of the posterior urethra in the region of the bladder neck, fibrosis of the prostate, hypertrophy of the bladder, bilateral hydroureter and hydronephrosis, bronchopneumonia, and focal hepatitis. The parathyroids were not examined.

Fig. 2. Case 1. Widening, cupping, and fraying of the outer end of the clavicle, with widening of the acromioclavicular joint space. Note also the widening of the epiphyseal cartilage at the upper end of the humeral shaft produced by decalcification of the adjacent metaphysis.

Fig. 3. Case 1. Widening of the epiphyseal cartilages of both femoral heads, with metaphyseal rarefaction and slipping of the necks upward on the heads.

Comment: In spite of the lack of confirmation of parathyroid involvement, this case is a classic example of renal osteodystrophy (so-called renal rickets) caused by congenital urinary tract obstruction, and its features conform to those described in the literature (3, 13, and 14). The changes at the acromioclavicular joints are empha-

Fig. 4. Case 2. Fraying and irregularity of the outer end of the clavicle, with widening of the acromioclavicular joint space, and irregular fraying of the articular surface of the acromion process. Note also the cystic changes in the lateral portion of the clavicle.

Fig. 5. Case 2. Diffuse decalcification and loss of contrast of the skull tables, with numerous dense nodular islands, changes simulating those of Paget's disease.

sized. Attention is also directed to the metaphyseal changes occurring at the shoulders and hips. Brailsford (3) states that it is possible for renal rickets to cause disintegration of the metaphysis of the upper end of the femur with consequent slipping without any further radiographic evidence of renal rickets. He makes no mention of acromioclavicular changes.

The next case is one of secondary hyperparathyroidism occurring with chronic uremia, hyperphosphatemia, and acidosis, the result of chronic glomerulonephritis.

CASE 2: A white female was found at the age of thirty-seven years to have hypertension. One year later she was admitted to the Johns Hopkins Hospital in uremic convulsions with severe azotemia, acidosis, anemia, and a low blood calcium. The urine specific gravity was low and fixed, and the phenolsulfonephthalein excretion was 0–2 per cent. Retrograde pyelography revealed small kidneys. Roentgen examination was reported as showing "punched-out areas in the skull, pathologic fracture of a rib on the left, and destruction of the distal portions of the clavicles." Biopsy of a cystic area of the left clavicle showed areas of osteitis fibrosa, and the consensus of opinion was that the bone lesions were secondary to long-standing renal insufficiency.

Fig. 6. Case 2. Irregular absorption of the ungual margins of the phalanges, periosteal palisading in the phalanges, and fibrocystic changes in the proximal phalanges of the fourth and fifth fingers.

During the following two years the patient received several blood transfusions for the severe anemia, and was hospitalized once again with uremic convulsions. At this time a bedside roentgenogram of the chest was made, and the shoulder region (Fig. 4) revealed cupping, fraying, and irregularity of the outer end of the clavicle, widening of the acromioclavicular joint space, and irregular fraying of the articular surface of the acromion process. A roentgenogram of the skull (Fig. 5), taken after improvement of the patient's condition, showed diffuse decalcification and loss of contrast of the skull tables, with numerous scattered dense nodular islands, changes which, except for lack of thickening of the tables, simulate those of Paget's disease. An

x-ray study of the hand (Fig. 6) revealed irregular absorption of the ungual margins of the phalanges, periosteal palisading in the phalanges, and fibrocystic changes in the proximal phalanges of the fourth and fifth fingers.

At the age of forty years the patient was admitted in a semicomatose state, with a blood pressure of 180/100. Reflexes were normal, and Trousseau's and Chvostek's signs were not elicited. The blood urea nitrogen was 120 mg. per cent, creatinine 7.6 mg. per cent, albumin 3.85 mg. per cent, globulin 3.05 gm. per cent, calcium 7.9 mg. per cent, phosphorus 8.3 mg. per cent, and CO_2 15.8 mM/L. Death ensued on the eighth day after admission, with evidence of cardiac decompensation and severe renal insufficiency.

Postmortem examination revealed advanced chronic glomerulonephritis, with markedly contracted kidneys. There was no evidence of nephrolithiasis, and x-ray and microscopic examination failed to reveal nephrocalcinosis. Samples of bone from the ribs, vertebrae, sternum, and skull showed changes characteristic of osteitis fibrosa cystica. The right inferior parathyroid body measured 3.0 × 2.0 × 1.3 cm. in diameter and weighed 10 gm. On microscopic examination, it showed a predominance of oxyphil cells. The other three parathyroid bodies each measured 1.0 × 0.5 × 0.5 cm. in diameter and on microscopic examination showed chief-cell hyperplasia.

Comment: Albright (1) states that, in rare instances, renal insufficiency of long duration may be accompanied by osteitis fibrosa generalisata and may be confused with primary hyperparathyroidism. It is probably the secondary hyperparathyroidism which prevents most patients with renal insufficiency from having severe tetany. Ginzler and Jaffe (6) state that the extensive osseous changes occurring in some cases of chronic renal insufficiency in adults may be regarded as the adult counterpart of those in "renal rickets" and, in both, a condition of secondary hyperparathyroidism (due to secondary parathyroid hyperplasia) is evidently partially responsible for the evolution of these changes. Snapper (14) has observed that, if the renal failure is accompanied by acidosis of exceptionally long duration, the hyperplasia of the parathyroids may lead to the formation of tumors of a considerable size.

Castleman and Mallory (4 and 5) have demonstrated that in primary hyperplasia of the parathyroids it is the large water-clear (*wasserhelle*) cells that are hyperplastic, in contradistinction to the chief-cell hyperplasia which occurs in chronic renal insufficiency. The finding of the large adenoma with oxyphil cells predominating, associated with chief-cell hyperplasia of the other parathyroid bodies, was confusing. However, Gutman (7) has found oxyphil adenomas at routine postmortem examinations in patients who have clinically manifested no evidence of hyperparathyroidism. The case, then, is presented as one of chronic renal insufficiency, with development of secondary hyperparathyroidism and osteitis fibrosa cystica. The acromioclavicular changes are emphasized.

Fig. 7. Case 3. Cupping, irregular absorption, and fraying of the outer end of the clavicle, with irregularity of the articular surface of the acromion process.

The third case is one of classical primary hyperparathyroidism.

CASE 3: A white male, aged 40 years, displayed the classical symptoms and findings of primary hyperparathyroidism. At postmortem examination, a large parathyroid adenoma was found within the mediastinum. Figure 7 illustrates the cupping, irregular absorption, and fraying of the outer end of the clavicle, and the irregularity of the articular surface of the acromion process. Figure 8 shows the

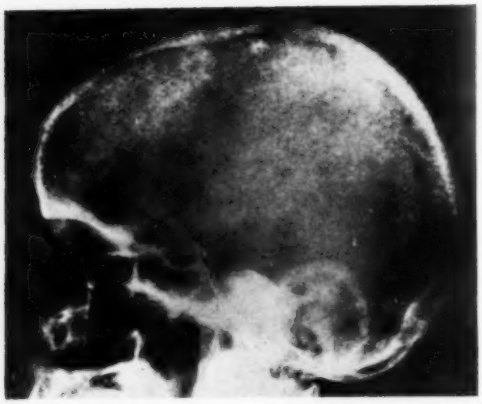


Fig. 8. Case 3. Marked decalcification of the skull bones, with loss of contrast between the skull tables and the diploe.

advanced punctate decalcification of the skull bones with marked loss of contrast between the tables and the diploe.

DISCUSSION

The three cases reported, each representing a different phase of hyperparathyroidism, all present, among other features, distinctive acromioclavicular changes. A search of the literature, made after observation of this finding, has disclosed several case reports of renal osteodystrophy in which acromioclavicular changes are described. Thus, Herbert, Miller, and Richardson (9) reported a case of chronic renal disease in a woman of forty, with decalcification of bones, metastatic calcification in the finger tips and in the soft tissue above the left acromioclavicular joint, destructive lesions of the acromioclavicular joints, calcification of the interosseous arteries of the hands, and extreme calcification of the splenic and iliac arteries. Autopsy disclosed advanced renal sclerosis and the presence of secondary parathyroid hyperplasia. Norman, Perlman, and Bastable (11) describe the case of a twenty-year-old soldier to whom attention was directed by undue prominence of the sternoclavicular joints. The patient showed evidence of a chronic uremic state with azotemia and hyperphosphatemia. The roentgenographic changes are summarized as "mild osteoporosis, stippling of the skull, delayed ossification at the epiphyseal cartilages in some areas, slipped humeral epiphyses, metaphyseal erosion, palisade-like periosteal new bone formation, and calcification of the media of the arteries." In addition, "the acromioclavicular and sternoclavicular joints appeared widened and a considerable part of these adjacent bones were not calcified."

Absence of acromioclavicular changes has also proved to be a valuable negative sign. We have failed to observe the sign in cases of severe senile or postmenopausal osteoporosis (10), cases of diffuse multiple myeloma, and a case of polyostotic fibrous dysplasia with extensive involvement, all conditions which must be differentiated from hyperparathyroidism. The negative value of absence of the sign was recently attested to in the case of a fourteen-year-old white boy who was admitted with severe pain in the back and marked lumbar muscle spasm. Blood pressure was 110/70. The urine showed a trace of albumin, occasional red and white blood cells, and hyalin and granular casts. X-ray examination of the spine showed a diffuse osteoporosis of all the vertebral bodies, with wedging and collapse of some of the bodies and biconcave deformity of others. In addition, there were mottled areas of rarefaction in the skull, ribs, scapulas, and both femurs. No acromioclavicular changes were present. Blood chemistry revealed: glucose 85 mg. per cent, urea nitrogen 40 mg. per cent, creatinine 1.8 mg. per cent, albumin 3.4 gm. per cent, globulin 3.6 gm. per cent, calcium 15.3 mg. per cent, phosphorus 4.2 mg. per cent and alkaline phosphatase 15 units per 100 c.c. On the basis of absence of acromioclavicular changes, the presence of the lamina dura in the alveolar sockets of the mandible, and the normal blood phosphorus level, the diagnosis of hyperparathyroidism was disfavored and a diagnosis of metastatic cancer was suggested, with acute osteoporosis due to immobilization of the skeleton in an actively growing boy (2). After a very short stay, the patient was transferred to another hospital, where exploration

failed to disclose the presence either of a parathyroid adenoma or of parathyroid hyperplasia.

CONCLUSION

1. Acromioclavicular changes are described in three cases of hyperparathyroidism, both of the primary type and of the secondary type due to chronic renal insufficiency.

2. Attention is directed to these changes in the hope that they will be checked and commented upon by other observers.

3. The negative value of absence of these changes is stressed as an aid in the differential diagnosis of hyperparathyroidism.

700 Ocean Ave.
Brooklyn 26, N. Y.

REFERENCES

1. ALBRIGHT, F.: The Parathyroids—Physiology and Therapeutics. J. A. M. A. **117:** 527–533, Aug. 16, 1941.

2. ALBRIGHT, F., BURNETT, C. H., COPE, O., AND PARSON, W.: Acute Atrophy of Bone (Osteoporosis) Simulating Hyperparathyroidism. J. Clin. Endocrinol. **1:** 711–716, September 1941.

3. BRAILSFORD, J. F.: Radiology of the Bones and Joints. Baltimore, The Williams & Wilkins Co., 4th ed., 1948.

4. CASTLEMAN, B., AND MALLORY, T. B.: Pathology of the Parathyroid Gland in Hyperparathyroidism: Study of 25 Cases. Am. J. Path. **11:** 1–72, January 1935.

5. CASTLEMAN, B., AND MALLORY, T. B.: Parathyroid Hyperplasia in Chronic Renal Insufficiency. Am. J. Path. **13:** 553–574, July 1937.

6. GINZLER, A. M., AND JAFFE, H. L.: Osseous Findings in Chronic Renal Insufficiency in Adults. Am. J. Path. **17:** 293–302, May 1941.

7. GUTMAN, A. B.: Personal communication.

8. GRANT, J. C. B.: A Method of Anatomy. Baltimore, The Williams & Wilkins Co., 4th ed., 1948.

9. HERBERT, F. K., MILLER, H. G., AND RICHARDSON, G. O.: Chronic Renal Disease, Secondary Parathyroid Hyperplasia, Decalcification of Bone and Metastatic Calcification. J. Path. & Bact. **53:** 161–182, September 1941.

10. NATHANSON, L., AND LEWITAN, A.: Deformities and Fractures of Vertebrae as a Result of Senile and Presenile Osteoporosis. Am. J. Roentgenol. **46:** 197–202, August 1941.

11. NORMAN, J. S., PERLMAN, R., AND BASTABLE, S.: Renal Osteodystrophy. J. A. M. A. **133:** 771–773, March 15, 1947.

12. OPPENHEIMER, A.: Lesions of the Acromioclavicular Joint Causing Pain and Disability of the Shoulder. Am. J. Roentgenol. **51:** 699–706, June 1944.

13. Editorial: Renal Rickets. Am. J. Roentgenol. **37:** 820–822, June 1937.

14. SNAPPER, I.: Medical Clinics on Bone Diseases; A Text and Atlas. New York, Interscience Publishers, Inc., 1943.

SUMARIO

Alteraciones Acromioclaviculares en el Hiperparatiroidismo Primario y Secundario

Comunícanse tres casos de hiperparatiroidismo, uno primario y dos secundarios a insuficiencia renal crónica, en los que se observó radiográficamente una típica alteración acromioclavicular, consistiendo en acopamiento del extremo externo de la clavícula, con desgaste debido a absorción irregular de la cara articular. Puede haber alteraciones similares, pero menos notables, en la cara articular del acromion, y puede haber o no dilatación del espacio de la articulación acromioclavicular.

No tan sólo se considera importante la presencia de este signo, sino que su ausencia ha resultado ser un auxiliar valioso en el diagnóstico diferencial, pues no se observó en casos de intensa osteoporosis senil o postmenopáusica o de mieloma múltiple difuso, ni en un caso de extensa displasia fibrosa poliosteótica.

Roentgen Diagnosis of Subdiaphragmatic Abscess[1]

PAUL S. FRIEDMAN, M.D.
Philadelphia, Penna.

AT THE PRESENT time, a period of four to five weeks elapses in the average case of subdiaphragmatic abscess before a definitive diagnosis is made and treatment is instituted. In many cases, diagnosis is made much later, even though the lesion is not rare. It is our purpose to emphasize the need and possibility of making an early diagnosis by drawing attention to the roentgen manifestations of this lesion, and to indicate the preponderance of thoracic phenomena in these manifestations.

In studying a patient suspected of having a subphrenic abscess, fluoroscopic and radiologic examination of the chest and abdomen should be performed in both the recumbent and the erect positions. Postero-anterior and lateral films of the thorax should be made, including high-contrast studies with the Bucky diaphragm. Films of the abdomen should include the diaphragm area with the patient erect. Upper and lower abdominal films should also be obtained in the recumbent position, so that the right subphrenic soft-tissue mass may be evaluated. Particularly when the left subdiaphragmatic area is being explored, barium sulfate should be administered to demonstrate displacements of the stomach. Occasionally, kymography and diagnostic pneumoperitoneum may be indicated.

One of the early evidences of subphrenic abscess is restricted mobility of the involved hemidiaphragm. This can be best demonstrated fluoroscopically. It must be carefully distinguished from the commonly occurring, though usually transitory, minimal reduction in mobility of the right hemidiaphragm which follows operation in the right upper quadrant of the abdomen.

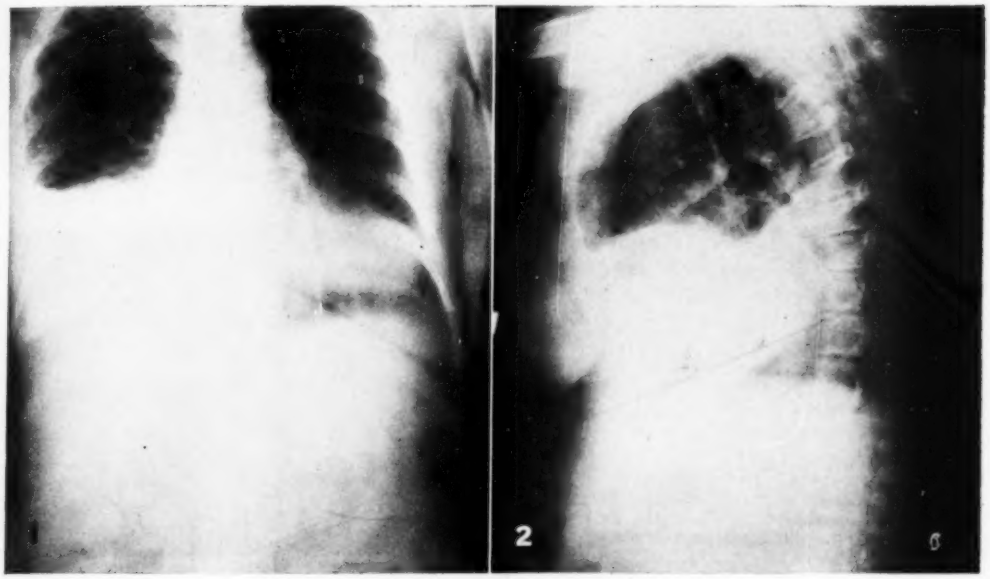
Elevation and fixation of the hemidiaphragm occur later. This change is more prominent and more readily evident on the right. Particular attention should be directed to the posterior aspect of the right hemidiaphragm. It normally slopes acutely caudad from its convexity. With abscess in the posterior suprahepatic space,[2] this slope is reduced and may be completely eliminated (Fig. 2). In addition to roentgenography and fluoroscopy, kymography may be helpful in evaluating these diaphragmatic phenomena. As the hemidiaphragm becomes elevated, the heart is frequently displaced to the opposite hemithorax (Fig. 1).

As a result of lymphatic extension of the infection a basilar pleurisy with effusion occurs, obscuring the costophrenic sulcus (Figs. 1, 3, and 6). This probably accompanies all suprahepatic abscesses. In addition to the studies mentioned, fluoroscopic examination should be done in the erect posture with the body tilted, and horizontal ray films in the lateral decubitus position should be obtained, to demonstrate the minimal pleural effusions. The changes may be evident as a fibrinous type of pleurisy with diffuse widening of what is apparently the diaphragmatic contour (Fig. 3 and 6).

Lobular atelectasis of the lower lobe usually accompanies the early changes (Fig. 3). As the lesion progresses, a lobular pneumonia occurs. This characteristically tends to involve the inferior segments of the lower lobe, following the contour of the hemidiaphragm (Fig. 4). It may usually be differentiated from a pneumonia of intrathoracic origin by its diaphragmatic localization and the

[1] Accepted for publication in July 1949.

[2] The subdiaphragmatic spaces are divided into right and left suprahepatic spaces, and right and left infrahepatic spaces. The right suprahepatic space is divided into anterior and posterior portions, as is the left infrahepatic space.



Figs. 1 and 2. Case 1: Right subdiaphragmatic abscess following cholecystectomy in a 59-year-old female. Fig. 1 shows marked elevation of the right hemidiaphragm, a right pleural effusion, and minimal displacement of the heart to the left. Fig. 2, a right lateral film, demonstrates further the elevation of the diaphragm on the right.

absence of dominant hilar involvement. These intrathoracic phenomena are extremely significant. They may dominate the clinical features, particularly in those cases involving the suprahepatic spaces, and may be the first suggestion of the presence of a subdiaphragmatic abscess; they should be regarded as an indication for careful roentgen exploration.

In about 25 per cent of cases the abscess may be visualized as an air-fluid accumulation in the subdiaphragmatic space (Figs. 3, 5, and 6). Examinations in the supine, lateral decubitus, and erect positions, in particular, should be made. The air is almost invariably due to communication with a hollow viscus, rather than to the activities of gas-forming bacteria. It must be distinguished from the routine accumulation of air following laparotomy.

On the right, the liver is displaced downward. This may be determined by measuring the vertical diameter of the subdiaphragmatic soft-tissue mass from the apparent superior surface of the right hemidiaphragm to the inferior pole of the liver. In the adult this normally averages 20 to 22 cm. on the film; in the presence of an abscess it will appear increased.

While most subdiaphragmatic abscesses are on the right, between 15 and 25 per cent occur on the left. In evaluating the presence of a left subdiaphragmatic abscess, ingestion of barium liquid during the examination is essential. Normally, the cardiac end of the stomach is in close contact with the left hemidiaphragm in the Trendelenburg position. In the presence of an abscess, it is displaced inferiorly and may be displaced medially and anteriorly (Figs. 6 and 7).

When the abscess is present in the right infrahepatic space, there is persistent dilatation of the stomach and proximal duodenum. This may be demonstrated on a survey film of the abdomen.

Diagnostic pneumoperitoneum may be of value. Normally air enters the subdiaphragmatic space. In the presence of abscess, adhesions prevent its entry. We have not, however, found it necessary to use this procedure.

Two representative cases are reported below. Three other cases are illustrated.

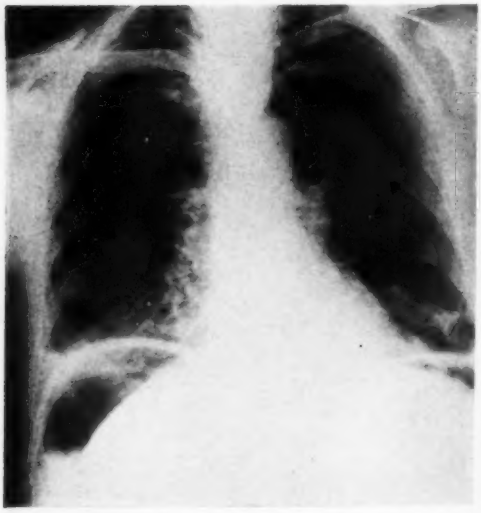


Fig. 3. Case 2. Subdiaphragmatic abscess following perforation of a gastric ulcer in a 50-year-old male. Bilateral pleural effusion, lobular atelectasis of lower lobes, widening of the diaphragmatic contour, subdiaphragmatic air-fluid levels.

REPRESENTATIVE CASES

CASE 2. C. D., a 50-year-old white male, a chronic alcoholic, was admitted to the Jewish Hospital on July 20, 1945, with a six-hour history of nausea, upper abdominal pain, and forced vomiting. He appeared poorly nourished and in acute distress. The temperature was 98.8°, pulse rate 82, and respiratory rate 22. The upper half of the abdomen was rigid, particularly in the epigastric region and right upper quadrant. The rest of the abdomen was moderately tender; peristalsis was audible. The white blood count was 7,830. The clinical diagnosis was pneumonia.

By July 22, the temperature was 101 and the pulse rate 120. On July 23, the white blood count was 22,000, and a friction rub was heard in the posterior right hemithorax. Roentgen examination (Fig. 3) on July 24 revealed a bilateral pleural effusion and a bilateral subdiaphragmatic air-fluid accumulation attributed to subdiaphragmatic abscess.

Operation was refused, and the patient remained intermittently febrile. Antibiotic therapy was given and on August 1, 400 c.c. of cloudy yellow fluid was aspirated from the right hemithorax.

On August 4, the patient consented to operation. A right upper quadrant incision was made. Pus was drained from the anterior surface of the liver, and between the liver and the anterior surface of the stomach. A pyloric perforation was closed.

The postoperative course was uneventful and the patient was discharged on Aug. 25, 1945.

CASE 3. F. J., a 12-year-old white male, was admitted to the Jewish Hospital on May 6, 1947, with a three-day history of abdominal pain, vomiting, and diarrhea. The temperature was 102°, pulse rate 120, and respiratory rate 30. The abdomen was tense, with marked tenderness in the right lower quadrant. Laparotomy revealed a retrocecal appendix which was gangrenous and had perforated. Much thick yellow fluid was present in the peritoneum. The abdomen was drained and antibiotic therapy was instituted.

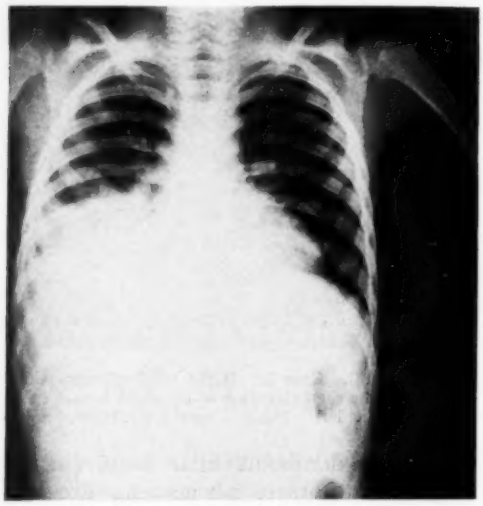


Fig. 4. Case 3. Right subdiaphragmatic abscess following suppurative appendicitis with rupture, in a 12-year-old white boy. Lobular pneumonia of the right lower lobe, accompanied by pleurisy and elevation of the right hemidiaphragm.

The temperature remained elevated, and on May 16, a pelvic abscess was localized. It was incised and drained through the rectum.

On May 29 and June 3, there was roentgen evidence of a right lower lobe segmental atelectasis and lobular pneumonia. The right hemidiaphragm was restricted in mobility but not markedly elevated or fixed. The possibility of right subdiaphragmatic abscess was considered, but a diagnosis could not be established. By June 9 (Fig. 4), roentgen examination revealed elevation and fixation of the right hemidiaphragm, a lobular pneumonia of the right lower lobe, and a right basilar pleurisy. The diagnosis of right subdiaphragmatic abscess was made, and operation was performed on June 10. The twelfth rib was resected, the peritoneum pulled away from the diaphragm, and an abscess found to the right of the liver. Incision and drainage were performed.

Because of roentgen evidence suggestive of a right empyema, a closed right thoracentesis was performed on June 23 and pus was aspirated. On June 24, a right thoracotomy was performed, with resection of the seventh rib, but no pus could be

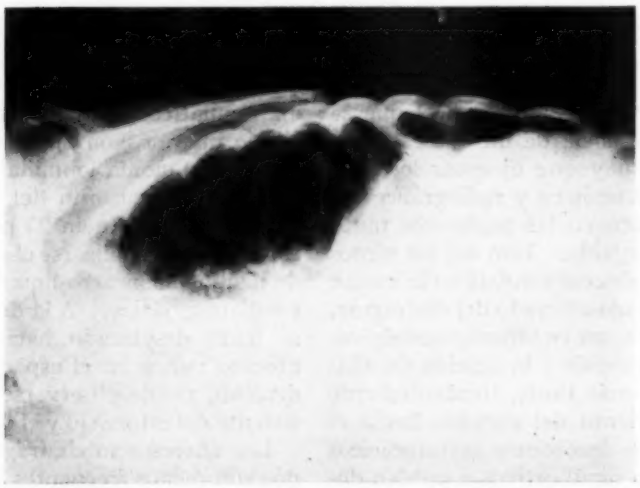
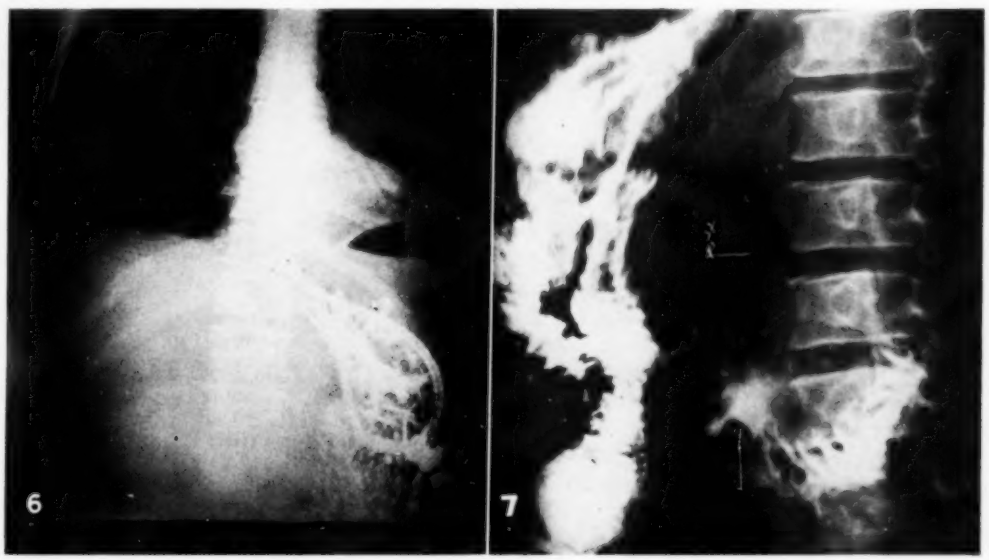


Fig. 5. Case 4. Right subdiaphragmatic abscess following cholecystectomy, in a 57-year-old white female. Left lateral decubitus film, taken with horizontal ray, demonstrating air-fluid level below right hemidiaphragm.



Figs. 6 and 7. Case 5: Left subdiaphragmatic abscess following first stage gastric resection for duodenal ulcer, in a 54-year-old white male. Fig. 6 shows medial displacement of the body of the stomach and inferior displacement of its cardiac end by a left subphrenic abscess. The abscess is visualized as a horizontal air-fluid level. A tube is present in the partially resected stomach. Left basilar pleurisy is also shown. Fig. 7, an oblique view, shows anterior displacement of the stomach.

evacuated. The subsequent course was uneventful, and the patient was discharged on July 20, 1947.

REFERENCES

CARTER, B. N.: Left Subphrenic Abscess. Ann. Surg. **110:** 562–577, October 1939.

GRANGER, A.: Radiological Signs of Subdiaphragmatic Abscess. New Orleans M. and S. J. **82:** 748–751, May 1930.

OCHSNER, A., AND GRAVES, A. M.: Subphrenic Abscess. Analysis of 3,372 Collected and Personal Cases. Ann. Surg. **98:** 961–990, December 1933.

MCNAMEE, E. P.: Subphrenic Abscess. Am. J. Roentgenol. **24:** 125–139, August 1930.

1422 Chestnut St.
Philadelphia 2, Penna.

SUMARIO

Diagnóstico Roentgenológico del Absceso Subdiafragmático

Al estudiar a un enfermo en el que se sospecha la presencia de un absceso subdiafragmático, hay que ejecutar los exámenes roentgenoscópico y radiográfico del tórax y abdomen en las posiciones tanto supina como erguida. Uno de los signos tempranos del absceso consiste en la menor movilidad del lado afectado del diafragma, que se observa mejor roentgenoscópicamente. La elevación y la fijación del diafragma vienen más tarde, frecuentemente con desplazamiento del corazón hacia el otro lado. Los fenómenos intratorácicos son sumamente significativos y pueden dominar el cuadro, comprendiendo: pleuresía basilar con derrame, con toda probabilidad presente en todos los abscesos subdiafragmáticos, y atelectasia lobulillar del lóbulo inferior, con aparición subsiguiente de una neumonía lobulillar que suele conformarse al contorno del hemidiafragma. Aproximadamente en 25 por ciento de los casos puede visualizarse el absceso en forma de acumulación aero-líquida en el espacio subdiafragmático. A la derecha, el hígado se halla desplazado hacia abajo. Si el absceso radica en el espacio infrahepático derecho, puede observarse dilatación persistente del estómago y el duodeno.

Los abscesos subdiafragmáticos izquierdos son menos frecuentes que los del lado derecho, acompañándose de desplazamiento inferior del extremo esofágico del estómago.

Treatment of Antral Cancer by Combined Surgery and Radium Therapy[1]

VINCENT P. COLLINS, M.D., and JOHN L. POOL, M.D.
New York, N. Y.

THE PURPOSE of this presentation is to detail steps of a method of treatment of cancer of the maxillary antrum by a combination of surgery and radium. The principles underlying the combined approach were outlined by Quick in 1930 (4). Extensive surveys of antral cancer in all its aspects have been published by Öhngren (3) and Windeyer (8).

Surgical treatment alone has produced survivals of five years and more. The failures of surgery have been due to the site and nature of the disease. Complete extirpation of the involved maxilla is technically difficult. By the time the patient presents himself for treatment, the disease has usually infiltrated beyond the confines of the maxilla and a block resection is impossible.

Irradiation alone has also produced survivals of five years or more. The failures of radiotherapy have been due to the difficulty of identifying the extent of involvement by physical examination and roentgenograms. Unless the disease can be accurately localized, unsuspected marginal extensions to the pterygoid fossa, the ethmoid air cells, or the floor of the orbit will receive less than a cancerocidal dose.

Surgical exploration permits a more accurate determination of the extent of the disease. The surgical pathologist should be present in the operating room so that sites of local extension can be identified by frozen sections. The radiotherapist should be present so that he may gain exact knowledge of the condition he will be called upon to treat.

With these points in mind, the steps in our procedure are now outlined.

SURGERY

Preparation for operation includes a general survey of the patient with particular reference to distant metastases and evaluation of respiratory, cardiac, and kidney function. Examination of the chest by x-rays, an electrocardiogram, blood urea nitrogen and blood sugar determinations, a complete blood count, and urinalysis are secured. Corrective and protective medicines are ordered as indicated. Locally, much reliance is placed on the benefits of mouth and nasal irrigations and power sprays. Intramuscular administration of penicillin is started twenty-four hours before operation.

The anesthesia is intravenous pentothal, supplemented by nitrous oxide and oxygen by way of an endotracheal tube passed through the opposite nostril. Passage through the mouth would interfere with the surgical manipulations. The pharynx is packed with a continuous strip of moist 3-inch gauze. When local anatomy prevents the use of the nasal passage, a preliminary tracheotomy under local anesthesia is carried out and the gas is introduced after the method of Schweizer (6). A tracheotomy is done in the very old and the very frail, preferably at the completion of surgery, to ensure an adequate airway during recovery from anesthesia and the ensuing few days. The external carotid artery is ligated in continuity on the side of surgery only when as near total resection of the maxilla as practicable is planned.

Limited Antrotomy: The operation itself may be limited to a peroral resection of the antral floor by actual cautery, hammer, and chisel or Stryker saw (Fig. 1A) (7). The incision is made through the hard

[1] From the Departments of Radiology and Surgery of the College of Physicians and Surgeons, Columbia University, and the Radiological and Surgical Services of the Presbyterian Hospital, New York. Presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

palate just off the mid line on the side of the disease, and carried into the floor of the homolateral nostril or antrum itself, as the extent of the disease requires. The posterior limit is the junction of hard and soft palates. The antral and ethmoidal linings are curetted out, leaving a permanent defect between oral cavity and antrum. If the medial antral wall is removed, communication is also established with the nasal passage. It is well to leave the maxillary tuberosity, for it will serve as an important point of rest for the reconstructive denture. This operation is especially applicable to lesions of the infrastructure, and when palliation only is intended because of extent of local disease, presence of metastases, or other chronic illness.

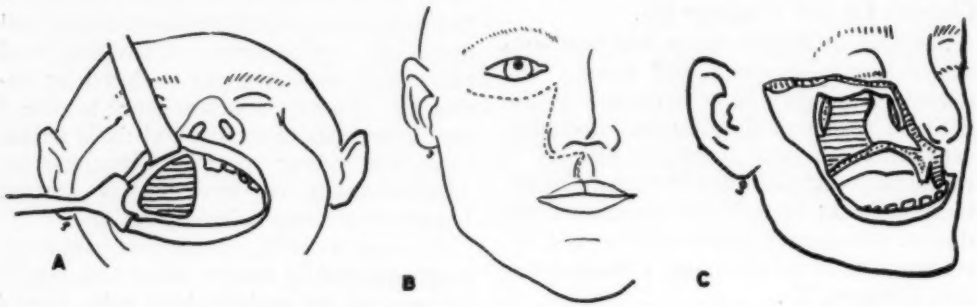


Fig. 1. A. Peroral antrotomy. Floor of the right antrum has been removed. Modified from Watson (7)
B. Dotted line indicates the extent of skin incision required for resection of the right maxilla.
C. Exposure after radical resection of the right maxilla allows full visualization, palpation, and biopsy of ethmoids, orbit, pterygoid fossa, and nasal passage. Modified from MacFee (2).

Radical Maxil ary Resection: A more radical resection of the maxilla can be carried out through the Weber-Ferguson incision (Fig. 1B), which allows the maxilla to be skeletonized on its anterior, lateral, and orbital faces. If disease has broken through bone, skeletonization cannot be accomplished in that area, and adjacent soft parts must be sacrificed with the maxilla. The zygoma and lacrimal bones are cut (Fig. 1C) (2). The hard palate is transected as in the limited operation, allowing removal of all but the posterior wall of the maxilla. A major portion of the infra-orbital plate may be removed without producing diplopia so long as the periosteum or the ocular fascial sling is left intact. Cancer extending into the orbit may be treated by subsequent radium or by immediate exenteration. Portions or all of the pterygoid muscles may also be excised. This operation is performed without cautery, and fine silk ligatures are employed. The best dressing is a split-thickness skin graft on a stent of fluffed gauze covered by vaseline gauze and placed prior to resuture of the cheek flap. The blood replacement requirement is around 500 c.c.

While the patient is still anesthetized, a No. 16 Robinson catheter is introduced through the nose into the esophagus so that high-caloric liquid feedings may be commenced the following day.

These patients are out of bed on the day following surgery, with good effect on ventilation and circulation. A tracheotomy tube is then in place; the patient is taught to aspirate his own tube frequently with a short whistle-tip catheter and the aid of a mirror, and is immediately given a "magic slate" to write messages on so as not to feel isolated. By the fourth or fifth day, the stent may be removed. A piece of foam rubber is cut to fit the palatal defect and may be worn without discomfort approximately one week following surgery, allowing a soft diet. Antibiotics are continued until the graft has taken or clean granulations are present. A radium applicator can usually be tolerated ten to fourteen days after surgery.

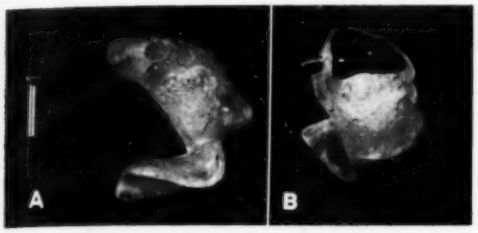


Fig. 2. A. Acrylic mold. B. Acrylic mold with area apposed to persistent tumor mapped out and drilled for radium source.

(Fig. 3), to demonstrate the position of the radium source, are taken at 2 meters to minimize distortion. Centering on the radium tube, a circle is drawn on the film to include the zone to be irradiated. In practice this will represent a sphere 3 to 6 cm. in diameter. As a rule a sphere larger than 6 cm. cannot be irradiated from a single source. This would require undue prolongation of treatment time, which is optimally between five and seven days.

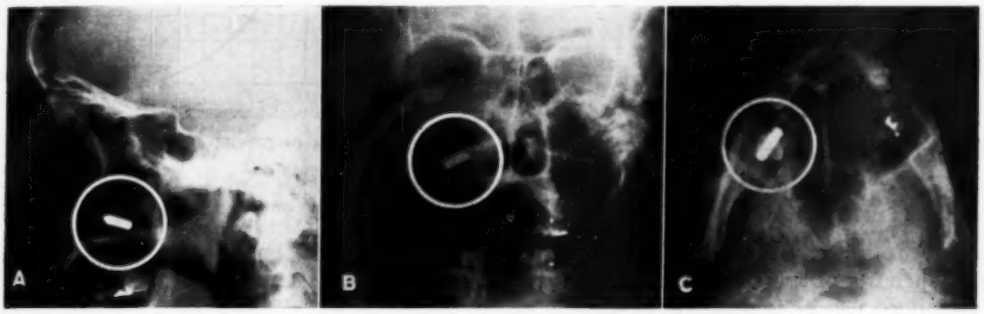


Fig. 3. Roentgenograms in three positions to demonstrate the location of the radium source, with the circle drawn to include tissue to be irradiated.

RADIUM THERAPY

An impression of the area is taken in dental compound on a suitable tray (1). The applicator is fabricated in clear dental acrylic on the model subsequently obtained (Fig. 2A). The applicator is retained in position by means of a modified Kingsley appliance attached to a head band. The surgeon and radiotherapist together map out the area on the surface of the mold which will be apposed to persistent tumor, and the mold is drilled below this area to accept the radium source (Fig. 2B). Since the tumor will usually involve only a portion of the wall of the cavity, the radium can be eccentrically located within the mold, thus sparing normal tissue from intensive irradiation. With a brass replica of the radium tube to avoid unnecessary exposure, the apparatus is fitted, its position is checked by roentgenograms, and dosage is calculated before treatment is begun.

Roentgenograms in three projections

For larger areas, x-ray therapy will be necessary. Dosage is calculated on the basis of roentgens delivered to the surface of a sphere (5), considering the radium as a central point source. The diameter of the sphere is obtained from the roentgenograms, and the number of roentgens delivered per 100 mg. hr. is obtained from Figure 4.

Figure 5 shows an example of the application of the dosage table. Radium dosage, when expressed as a single value, usually indicates the minimum dosage in the volume irradiated. The maximum dosage delivered in standard procedures is rarely determined and may be surprisingly high. The expression of both maximum and minimum dosage is desirable whenever practical. In this instance, the maximum dosage indicates that a caustic dose of radiation is delivered, and that sloughing reaction in the wall of the cavity will occur.

The maximum reaction will develop in ten to fourteen days, but clean granula-

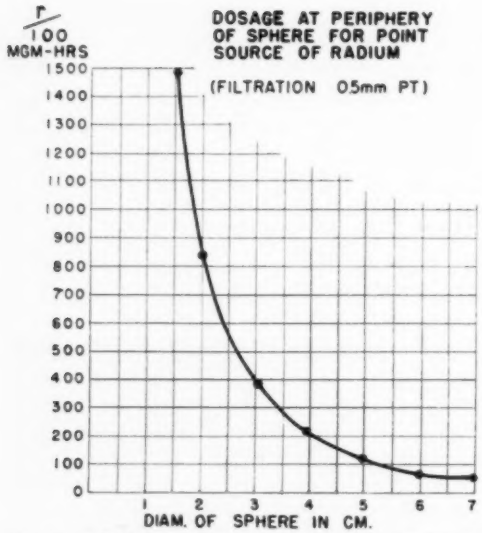


Fig. 4. Graph of radium dosage for point source.

tions are not expected before two months. The penalty of this severe treatment for an advanced cancer is a period of four to six months of local discomfort to the patient and prolonged, untiring supervision on the part of the doctor. Removal of slough by power spray and scissors will be necessary at frequent intervals. The cavity is irrigated by the patient six times a day with normal saline, with an irrigation can, rubber tubing, and a tapered glass tip. This should be used with sufficient pressure to dislodge slough, coagulum, and food particles. Each irrigation may be followed by a spray of a bacteriostatic agent such as sulfamylon, to diminish or control any element of infection. The patient is kept on a high-caloric and high-vitamin diet. When maximum contracture of scar tissue in the walls of the cavity has occurred, the operative defect can be closed by an upper plate prosthesis. This will usually be after an interval of four to six months.

SUMMARY

In the treatment of cancer of the antrum, surgical and radiation methods supplement each other. The initially planned cooperation of the surgeon and the radiotherapist permits the most effective application of the advantages of each method.

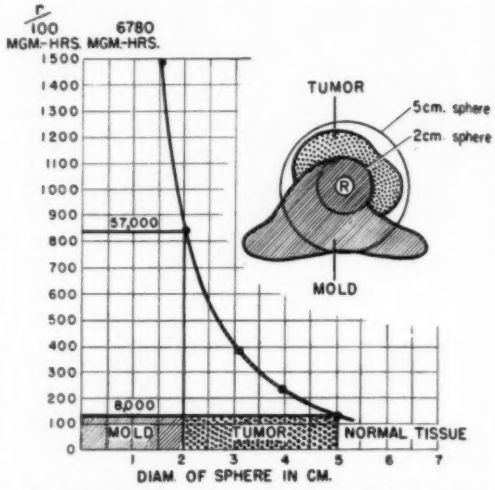


Fig. 5. Same graph as Fig. 4, adapted to a particular dosage problem. The insert represents a mold with a 50-mg. tube of radium imbedded at R. The residual tumor is included within a 5-cm. sphere, centered on the radium source. The radium is imbedded at a minimum depth of 1 cm. in the mold and therefore the radiation in the inner 2-cm. sphere has no direct effect on the tissue. The effective irradiation is delivered to tissue between the 2-cm. and 5-cm. spheres.

A dose of 8,000 r is planned at the periphery of the 5-cm. sphere. From the graph: 100 mg. hr. delivers 118 r; 6,780 mg. hr. delivers 8,000 r.

For an exposure of 6,780 mg. hr. the maximum dose at the surface of the mold (periphery of 2-cm. sphere) is 57,000 r.

The steps in the combined management of such a patient are outlined in detail.

622 West 168th St.
New York 32, N. Y.

REFERENCES

1. BEDER, O. E.: Surgical and Maxillofacial Prosthesis. New York, King's Crown Press, Columbia University, 1949.

2. MACFEE, W. F.: Resection of the Upper Jaw for Malignant Tumors. In PACK, G. T., and LIVINGSTON, E. M.: Treatment of Cancer and Allied Diseases. Paul B. Hoeber, Inc., 1940. Vol. 1, pp. 471–478.

3. ÖHNGREN, L. G.: Malignant Tumors of the Maxillo-Ethmoidal Region: Clinical Study with Special Reference to Treatment with Electrosurgery and Irradiation. Acta Oto-laryng., Supplement 19, 1933.

4. QUICK, D.: Treatment of Malignant Growths of the Nasal Accessory Sinuses and Nasopharynx. Radiology **14:** 191–196, 1930.

5. QUIMBY, E. H.: Physical Factors in Interstitial Radium Therapy. Am. J. Roentgenol. **33:** 306–316, 1935.

6. SCHWEIZER, O.: Pentothal Sodium Anesthesia for Operations about the Head and Neck, Experiences with 1004 Cases. Cancer **2:** 223–244, 1949.

7. WATSON, W. L.: Cancer of the Paranasal Sinuses. Laryngoscope **52:** 22–42, 1942.

8. WINDEYER, B. W.: Malignant Tumours of the Upper Jaw. Brit. J. Radiol. **16:** 362–366, 1943; **17:** 18–24, 1944.

SUMARIO

Tratamiento del Cáncer del Seno Maxilar con la Cirugía y la Curieterapia Combinadas

En el tratamiento del cáncer del antro de Highmore, las técnicas quirúrgica e irradiatoria se complementan. La colaboración planeada de antemano entre el cirujano y el radioterapeuta permite la más efectiva aplicación de las ventajas de ambos métodos. Bosquéjanse aquí con todo pormenor los distintos tiempos de esta asistencia combinada.

La operación misma puede limitarse a una resección peroral del piso del antro o quizás comprenda una resección más radical del maxilar.

El radio se aplica en un molde construído *ad hoc*. Con una copia en bronce del tubo de radio, para evitar toda exposición innecesaria, se ajusta el aparato, se comprueba su posición con roentgenogramas y se calcula la dosis antes de iniciar el tratamiento. El cálculo es a base de los roentgens llevados a la superficie de una esfera, considerando el radio como foco del punto central. El diámetro de la esfera se obtiene de las radiografías y el número de roentgens entregados por 100 mg.-h. de la gráfica reproducida en la Figura 4. Por regla general, no puede irradiarse de un solo foco una esfera de más de 6 cm. de diámetro.

Por regla general, puede tolerarse un aplicador de radio de diez a catorce días después de la intervención cruenta.

Treatment of Carcinoma of the Nasopharynx by Irradiation[1]

THEODORE P. EBERHARD, M.D., and ROBERT H. LEAMING, M.D.[1]

Philadelphia, Penna.

THE TREATMENT of carcinoma of the nasopharynx by irradiation involves three basic problems: the localization of the lesion, the delivery of an adequate tissue dose, and the maintenance of the patient's health through the ordeal.

The primary diagnosis of these tumors is often essentially an exercise in localization, since they are prone to produce bizarre and apparently unrelated symptoms long before any local tumor is obvious. Enlarged firm nodes in the neck are the commonest presenting symptom. Strabismus, trigeminal neuralgia, diplopia, unilateral exophthalmos, are all more common than the expected symptoms of epistaxis and nasal obstruction. The privilege of making the original diagnosis is, however, seldom given to the radiologist unless he is a member of a tumor clinic. It has generally been made by the nose and throat specialist or the neurologist before the patient comes to the radiologist. Still, the radiotherapist must become proficient in the examination of the nasopharynx, since only by visualizing the tumor himself can he plan and direct his fields correctly. This is no idle chatter. One cannot accept a verbal description given by someone else. Furthermore, if the radiotherapist will examine the nasopharynx frequently while treating cases with metastatic cervical nodes of unknown origin, he will ultimately find the primary tumor in almost every instance.

One must employ both mirror examination and the nasopharyngoscope. Next in importance comes the x-ray examination. The two most useful projections are the lateral and submento-vertical or base views, though in selected cases Waters, Caldwell, Stenvers and mastoid positions may contribute information of value. These tumors most frequently arise in the mucosa and submucosa of Rosenmüller's fossa and of the posterior pharyngeal wall, but they may have their origin at the very apex. Restricted as they are by dense fibrous fascial planes, they follow the lines of least resistance, along the great vessels and nerves into the lacerate, round, and carotid foramina. From here they invade subdurally to destroy the sphenoid and the ethmoid and orbital structures anteriorly, and occasionally the petrosae and basi-occiput posteriorly. Only with good quality stereoscopic base views can the early degrees of bone involvement be detected, since slight errors of angulation will create quite fallacious appearances in single films. In cases with clinical evidence of orbital involvement, special views of the orbital walls, orbital fissures, and optic foramina will be necessary. The lateral view serves two purposes. First, it is essential in determining the limits of lateral treatment fields and the angulation necessary for the forehead field, if one is used. Second, it will sometimes reveal unsuspected infiltration down along the posterior pharyngeal wall, manifested by widening of the prevertebral shadow or even erosion of the anterior margins of the vertebral bodies.

A biopsy of the primary lesion must be obtained whenever possible. About 40 per cent of malignant nasopharyngeal tumors are squamous-cell carcinomas, and 40 per cent lymphosarcomas. A small group, 10 per cent, are lymphoepitheliomas, extremely radiosensitive lesions whose histogenesis is still a matter of argument among pathologists. The remaining 10 per cent is comprised of an assortment of

[1] From the Department of Radiology, Jefferson Medical College and Hospital, Philadelphia, Penna. Presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

adenocarcinomas, plasmocytomas, and other tumors. The differentiation between the carcinomas, lymphoepitheliomas, and lymphosarcomas is relatively unimportant so far as treatment is concerned, since the individual variations in radiosensitivity within each group are so great as to make it unsafe to reduce the dosage simply because of the histology. It is of considerable prognostic import, however, for most of one's successes will be in the lymphosarcoma and lymphoepithelioma groups, and only a few among the differentiated carcinomas.

A knowledge of the prognosis is itself of importance in planning the treatment, and the outlook is almost completely dependent upon the presence or absence of bone involvement. In its absence, one may expect nearly 40 per cent salvage of these cases for five years or more; with it, only about 10 per cent will survive. One is justified in battling almost any systemic, psychologic, and economic odds in order to obtain adequate tumor dosage when there is a 40 per cent chance, but it is definitely not correct to push things too far when age, pain, debility, and other factors have already reduced a possible 10 per cent chance to a hollow mockery of success.

Only after all possible information is at hand can one outline a treatment plan. The ideal goal is the administration of a minimum of 4,000 to 4,500 r to all parts of the tumor in four weeks. When the disease extends from the orbits to the foramen magnum and down to the clavicles, this obviously is impossible. Some sort of compromise must always be made in these very extensive cases. One has three choices. First, he may treat the primary tumor and its adjacent extensions first and the lymph node masses later. Second, he may reverse this order. Third, he may treat the entire area at once, increasing the total dose in order to compensate for the prolonged treatment time. It is our general practice to choose the third course.

Four fields (Fig. 1) constitute the main eliance for treatment of the primary lesion,

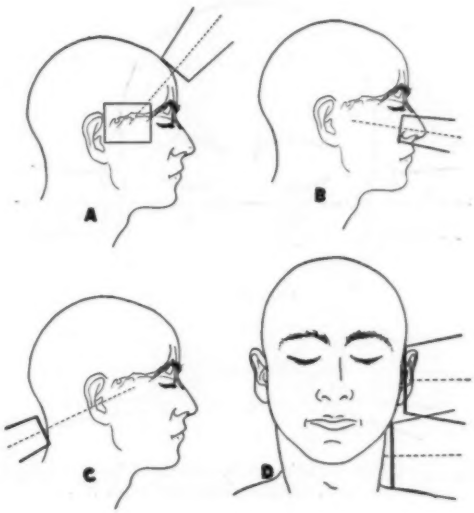


Fig. 1. Fields commonly used for nasopharyngeal tumors. A. The lateral or temporal field, size and shape being chosen appropriately for the individual, and the frontal field used only with anteriorly invasive tumors. B. The antral field. C. Occipital field, used only on very thin individuals with posterior tumors. D. Temporal and cervical fields covering both the primary tumor and cervical metastases.

two lateral fields and two antral fields. The size and shape of the lateral fields will depend upon the location and extent of the tumor. When the site is high and there is actual or presumptive evidence of invasion of the base of the skull, the fields must be large enough to cover all of the involved area. In such cases, the best coverage of the tumor with the least exposure of uninvolved tissue may be achieved with a rectangular field. In other instances, circular or oval fields may be more efficient. The use of a single lateral field to include the primary growth and the cervical metastases is seldom advisable. The central beam and the greatest depth dose with such a field falls about the level of the lower border of the mandible. It is true that such large fields give good depth dosage and saturate the entire volume of tissue with a minimum of attention from the therapist. Unfortunately, this result is accompanied by extremely extensive and severe mucous membrane and skin reactions, which are generally most marked in areas where there is the least tumor.

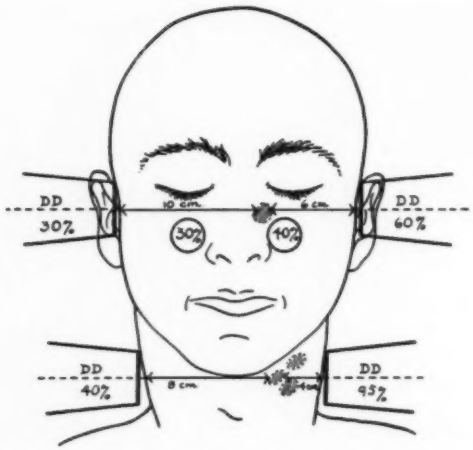


Fig. 2. Characteristic doses, expressed in percentage of air dose, received from various fields.

We believe it is preferable to use two smaller fields, one directed to the nasopharynx and the other to the cervical nodes. Care must be taken, of course, to avoid overlapping on the skin or omission of vital parts of the deeper structures. I may say at this point, also, that we do not believe in irradiation of the entire cervical region in the absence of palpable node involvement. This is another argument against the use of extremely large fields.

The frontal approach may be made through a single large field with lead protection for the eyes, but again we believe that in the majority of cases equally good coverage of the affected area can be achieved, with less unnecessary exposure of uninvolved tissue, by means of two small fields directed through the antra. Accurate placement of all of these fields is extremely important. Careful correlation of the physical findings, the bony landmarks, and the roentgenograms must be made in every case before treatment is begun, and exact duplication of locations and angles must be made each day.

When the tumor is high and has invaded forward, a forehead field may be of value in supplementing the tumor dose. Again, careful measurements of distances and angles must be made and exact duplication of the technic carried out each day.

One large or two small suboccipital fields have been advocated by some workers. We believe that these fields are useful only in the very rare case where the patient has an extremely thin neck and a tumor on the posterior wall with invasion toward the spine. In the average case, not more than 10 per cent depth dose will be achieved in the nasopharynx.

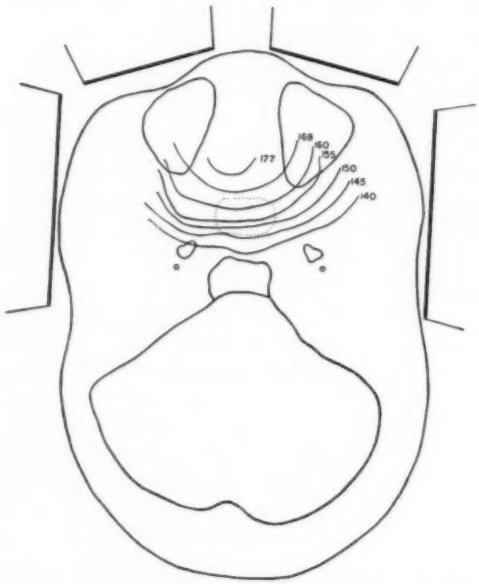


Fig. 3. Isodose contours representing the summation from four fields each receiving 100 r measured in air. Lateral fields 10 × 10 cm. Antral fields 5 × 5 cm. Dotted oval represents the cavity of the nasopharynx. Obviously, the lateral fields should be moved posteriorly and receive proportionately more than the antral fields in this case in order to produce a closed contour line of highest intensity in the nasopharyngeal region.

The cervical node-bearing region is usually treated simply with lateral fields. Sometimes, when only one node is palpable, nothing will be used but one small field. More frequently, bilateral involvement of multiple nodes will necessitate the use of a moderately large field on each side. In extreme cases, bulky masses will have to be attacked by anteroposterior crossfiring, as is often done in thyroid carcinoma.

Isodose curve overlays (Fig. 2), which can be placed on roentgenograms of the patient, provide the best means of plan-

ning the field layout and apportioning the parts of the total dose to individual fields. Lacking such charts, one may make use of ordinary depth dose tables, but when this is done, the therapist must visualize mentally, with the utmost care, the extent of his fields and allow for the decrease of intensity along the margins.

thoroughly familiar with the dose patterns to be expected with various field arrangements and dosages.[2]

The daily dose per field, the daily total tissue dose, and the order of rotation of the fields must be individualized and will often have to be modified from day to day during a course of treatment.

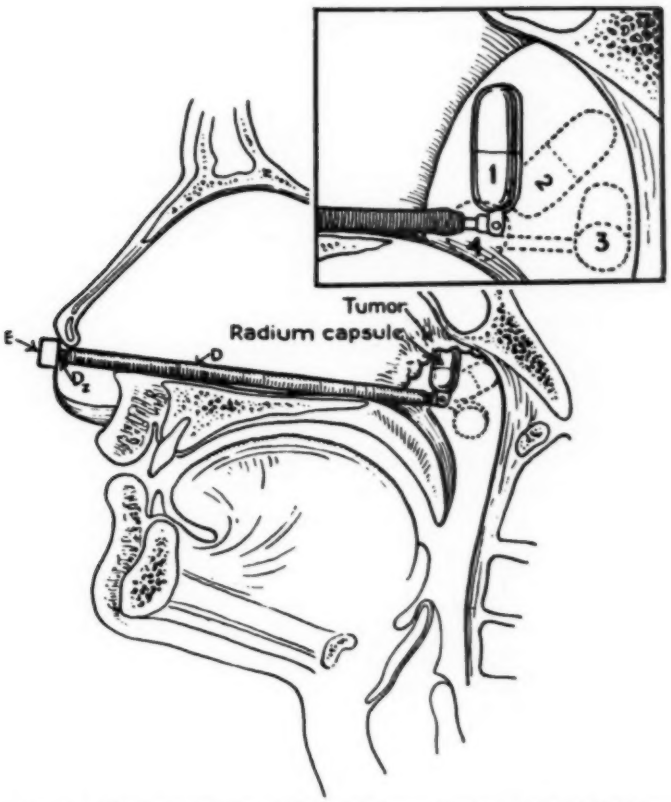


Fig. 4. Schematic diagram of Blady applicator in place. (Reprinted from Martin, H. E., and Blady, John V.: Cancer of the Nasopharynx, Arch. Otolaryng. **32:** 692–727, 1940.)

A most useful exercise when planning a treatment program is the making of an isodose contour map (Fig. 3). Only in this way can one visualize the actual cumulated tissue dose from all of the fields at all points within the irradiated mass. It is not practical to do this routinely, since it takes about three days of hard work for each one, but every therapist should do it a few times to become

The following is an example: the situation required six fields—two lateral skull fields, two antral fields, and two neck fields. The contributions from the four fields directed to the primary tumor made 2,500 r air dose to each lateral field and 3,000 r to each antral field appear desirable.

[2] Material in this paragraph contributed by Dr. Richard H. Chamberlain, University of Pennsylvania, during the discussion.

The cervical fields were to receive 3,000 r each. Thus 17,000 r were to be delivered in six weeks or thirty-six treatment days. This meant 472 r per day or, roughly, 250 r to each of two fields. Actually, we started with 200 r to one lateral temporal field and 200 r to one neck field each day, intending to compensate for this by going above 250 r toward the end of the treatment. A severe mucositis developed in the pharynx requiring suspension of the treatment on the neck for a few days and resumption at a lower dose rate. The patient's general condition remained good, however, thus making it possible to maintain the total daily dose rate by starting treatment through the antral fields. In this way, we were able to maintain the original schedule. Too often, such juggling cannot be done. One must then resign himself to an extension of the treatment time.

If, because of severe skin reaction, or because of high radioresistance of the local lesion, it appears that sufficient radiation cannot be delivered to the nasopharynx through the external portals, radium may be applied locally. Many gadgets have been devised for this purpose. The simplest is a small cork with a hole in which a platinum-filtered radium tube may be inserted. Two heavy threads are tied to this. A fine catheter is inserted through the nose and brought out through the mouth, one of the threads is tied to it, and the cork is pulled up tight against the posterior choana. The other thread remains hanging out of the mouth for use in removal of the cork. A dental roll against the nostril acts as an anchor to hold the cork in place. This device is most valuable in lesions of the vault or posterior wall but is of little value for lateral wall lesions.

The Blady (1) applicator (Fig. 4) is probably the best and most widely used of the more complicated gadgets. The rather stiff metal handle makes it difficult sometimes to bring the radium holder around the edge of the palate into the nasopharynx, but, once this is accomplished, a more accurate placement can be obtained than with the simple cork. Patients can tolerate either one for long periods and can sleep with them in place with little or no sedation.

With the aid of the linear dose tables available today, dosage can be accurately calculated for these local sources and on occasion they may be extremely valuable, but primary reliance should never be placed on them.

The general medical care of these patients is often difficult. For periods ranging from two weeks to three months they are unable to take proper nourishment. They become dehydrated, avitaminotic, weak and depressed. Because of pain, dryness of the mouth, and loss of taste sensation, all thought of food or drink is abhorrent. A fair percentage become actually unable to swallow. The psychologic aspect assumes great importance. Before the treatment is started, we believe in giving both the patient and the family as dark a picture of the sequence of the events of the reaction as possible. Even so, they never believe it can be as bad as it really becomes, but at least they are less frightened and their confidence in the therapist is heightened when he is able to remind them that he had warned them, that he knew what was coming, and had planned for it. A cooperative family often means the difference between carrying a patient through on an out-patient basis and hospitalization halfway through the course. Again and again the patient and his family must be impressed with the importance of maintaining caloric and liquid balance by every device possible. The administration of the whole B-complex, either by mouth in the form of brewer's yeast or parenterally with some preparation like Paren-B complex, helps greatly. A few patients will require hospitalization and tube feeding.

In the end, the results (Table I) will depend to a large extent upon the quality of the material received. My personal experience is illustrative. From 1936 through 1939, I took part, with Dr. Kasabach, in the treatment of 20 cases in New York City. A recent review showed

TABLE I: PROGNOSIS IN THE TREATMENT OF CARCINOMA OF THE NASOPHARYNX

Name of Author	Number of Cases	Number of 5-Year Survivals	Per Cent of 5-Year Survivals	Date of Article
Godtfredsen	266	59	22	1944
Baclesse	102	16 (4-year)	15 (4-year)	
New	271	35	13	1943
Martin and Blady	80	20	25	1940
Simmons and Ariel	78	7	10	1949
Lenz	44	13	27	1942
Nielsen	37	9	24	1945

5 patients alive and well after ten years. In a sixth there was a recurrence, with death in the eighth year. During the next three years I treated 9 cases at the Ellis Fischel State Cancer Hospital in Missouri, using exactly the same technics. Four patients were dead in three months, 2 more within two years, and only 1 survived over three years. He is still well. Worthwhile palliation in the form of relief of pain and headache will be achieved for periods varying from six months to three years in about 70 per cent of the patients. Godtfredsen reported a five-year cure rate of 13 per cent in 74 patients with x-ray evidence of bone destruction in the base of the skull. We have never cured such a patient. Lymph node involvement presents no such serious handicap. At least 85 per cent of the patients coming to almost any clinic will have demonstrable lymph node metastases, but still 20 per cent or more of these can be salvaged if carefully and adequately treated.

The success of therapy is dependent upon (1) early diagnosis, (2) careful localization of the disease, (3) careful planning of the treatment fields, and (4) meticulous attention to details during the treatment.

Jefferson Medical College
1025 Walnut St.
Philadelphia 7, Penna.

REFERENCES

1. MARTIN, H. E., AND BLADY, J. V.: Cancer of the Nasopharynx. Arch. Otolaryng. **32:** 692–727, 1940.
2. GODTFREDSEN, E.: Malignant Tumors of the Nasopharynx. Acta Oto-laryng; Suppl. 59. Cited in Brit. M. J. **2:** 324–325, 1945.
3. BACLESSE, F., AND DULAC, G.: Les tumeurs malignes du rhinopharynx. Bull. Assoc. franç. p. l'étude du cancer **31:** 160–177, 1943.
4. NEW, G. B., AND STEVENSON, W.: End Results of Treatment of Malignant Lesions of the Nasopharynx. Arch. Otolaryng. **38:** 205–209, 1943.
5. SIMMONS, N. W., AND ARIEL, I. M.: Carcinoma of the Nasopharynx. Report of 150 Cases. Surg. Gynec., & Obst. **88:** 763–775, 1949.
6. LENZ, M.: Roentgen Therapy of Primary Cancer of the Nasopharynx. Am. J. Roentgenol. **48:** 816–832, 1942.
7. NIELSEN, J.: Roentgen Treatment of Malignant Tumors of the Nasopharynx. Acta radiol. **26:** 133–154, 1945.

SUMARIO

Tratamiento del Carcinoma de la Nasofaringe con la Irradiación

El tratamiento del cáncer nasofaríngeo plantea tres problemas fundamentales: localización de la lesión, entrega de una adecuada dosis y mantenimiento de la salud del enfermo durante la prueba.

Al planear el tratamiento, reviste mucha importancia la determinación del grado de invasión ósea, dado que el pronóstico depende en gran parte de ese factor. Sino existe tal invasión, cabe esperar un 40 por ciento de sobrevivencias de cinco años, pero si la hay, la cifra baja a 10 por ciento.

La meta ideal de la terapéutica consiste en llevar a todas las partes del tumor un mínimo de 4,000 a 5,000 r en cuatro semanas. Cuatro campos: dos laterales y dos antrales, constituyen la base principal para el tratamiento de la lesión primaria. Hay que tener cuidado de evitar la sobreposición en la piel y la omisión de partes vitales de los tejidos más profundos. La zona ganglióferа cervical suele ser tratada a través de los campos laterales. La dosis diaria por campo, la dosis histólogica total y el orden de rotación de los campos son puntos que deben ser individualizados y a menudo modificados de día en día durante una tanda de tratamiento. Puede necesitarse aplicación complementaria de radio. La asistencia general de esos enfermos resulta en particular difícil. Hay que prestar la atención más minuciosa al mantenimiento de una adecuada ingestión calórica y líquida.

Supervoltage Roentgen Therapy in Cancer of the Mouth and Throat[1]

MILFORD D. SCHULZ, M.D.

Boston, Mass.

SUPERVOLTAGE radiation in the treatment of malignant tumors has become an established procedure. Experience in the use of this tool, however, has been limited, largely because of the high cost and the restricted availability of the equipment. With the increasing number of generators operated at potentials of one million volts or more, it is important that the place which supervoltage (1,000–3,000 kv.) occupies in the therapy of malignant disease be established, particularly in comparison with that of the conventional radiation therapy at 200 and 250 kv. A considerable literature concerning the physical and clinical merits of supervoltage x-rays is accumulating, and the general conclusions in all reports are quite in concord. In this presentation, the use of supervoltage radiation in treating malignant lesions about the mouth and throat will be considered.

These parts of the body constitute a region in which the dimensions are relatively small and in which no tumor is situated very far from the surface. This makes the problem of radiation treatment quite different from that which obtains in the chest, abdomen, and pelvis, where often the tumor is so deeply buried as to limit the amount of radiation that can be delivered to it by conventional means.

The employment of any new tool for the treatment of malignant disease should be examined primarily from two major standpoints: (1) its effectiveness in ridding the patient of his disease; (2) the degree of harm to normal tissue required to accomplish this. Of secondary importance is the consideration, from the radiologist's point of view, of the facility of use and efficiency of operation of the method.

No clinical or experimental evidence has as yet been advanced to show that there is any marked alteration in the biologic effectiveness of supervoltage radiation, in the ranges now commonly employed, as compared with 200 to 250 kv. In fact, there is some indication experimentally that the efficiency of the former is somewhat less, but so far as clinical observation is concerned, this factor does not seem to be great enough to play any notable part in tumor response or in treatment planning (1, 5, 6). Accordingly, any improvement in ridding the patient of his malignant disease by means of supervoltage radiation must lie principally in the physical factors which allow the delivery of a larger, but not necessarily a more effective, tumor dose more efficiently. No tumor about the head and neck is located so far from the surface of the body that failure to control its activity can be attributed to inability to deliver a sufficient amount of radiation to it by means of the conventional 200-kv. x-rays, sometimes supplemented with interstitial radiation, if ingenuity and care are employed. (This is contrary to the situation which at times obtains elsewhere in the body.) Failure to achieve success is usually due to inexperience, to some error in technic, or to an inherent attribute of the tumor itself—its radioresistance or the stage of advancement of the disease. The mere act of reducing wave length cannot be substituted for experience and careful treatment planning. Experience gained in determining optimum tumor doses in the past by the use of 200-kv. x-rays will serve the radiologist treating patients with supervoltage radiation in good stead.

All other things being equal, it is generally conceded, with a few exceptions, that in the treatment of carcinoma about the head

[1] From the Department of Radiology, Massachusetts General Hospital, Boston, Mass. Presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

TABLE I: INOPERABLE CARCINOMA OF THE TONGUE TREATED WITH X-RAYS AT MASSACHUSETTS GENERAL HOSPITAL

No. Years from Onset	Supervoltage Treatment					200-kv. Treatment					Total
	Without Disease		With Disease		Total	Without Disease		With Disease		Total	
	Dead	Living	Dead	Living		Dead	Living	Dead	Living		
1 or less	0	0	12	0	12	0	2	42	0	44	56
1–2	0	0	13	1	14	1	0	26	1	28	42
2–3	0	1	3	0	4	0	0	9	1	10	14
3–4	0	1	4	0	5	0	1	2	0	3	8
4–5	0	0	1	0	1	0	2	2	0	4	5
Over 5	0	1	5	0	6	4	4	1	0	9	15
TOTAL	0	3	38	1	42	5	9	82	2	98	140

and neck, supervoltage as now employed has not been spectacularly more effective than x-rays generated at 200 to 250 kv., proper technic and skill based upon experience being assumed in both instances. The twelve years experience with supervoltage radiation at the Massachusetts General Hospital and the Collis P. Huntington Memorial Hospital[2] has borne out this conclusion. For the purposes of the present discussion, two representative types of cancer in the mouth and throat, that is, cancer of the tongue and of the tonsil, have been chosen for comparison of the respective therapeutic methods.

Carcinoma of the tongue is represented by a group of 140 cases treated at the Massachusetts General Hospital. In the Tumor Clinic at this hospital only cases which are inoperable because of the advanced stage of the disease, because of involvement of adjacent structures, or because the tumor is located at the base of the tongue are given radiation therapy. Of the 140 cases, 42 were treated with supervoltage and 98 with 200-kv. technic. In both instances the average tumor dose was 5,000 r or more. The selection of the technic was quite random. Of patients treated with supervoltage radiation, 33 (80 per cent) had died of cancer within five years after the onset of the disease; of the 98 treated with 200-kv. radiation, 81 (82 per cent) had followed the same course (Table I). These results are not greatly at variance with those of a smaller group which had been treated with supervoltage x-rays at the Massachusetts General and the Collis P. Huntington Memorial Hospitals and previously reported (2). In this latter group, 9 per cent of patients with advanced and inoperable carcinoma of the tongue survived five years or more after treatment.

Essentially the same conclusions as to the value of supervoltage radiation in the treatment of malignant disease about the mouth and throat have been drawn by Leucutia (4), although his over-all survival is somewhat higher. Cantril and Buschke (1), in a paper presented before this Society a year ago, reported a very small group of cases of cancer at the base of the tongue, in which 5 of 6 patients remained symptom-free over periods of seven to three years. These figures, though not large enough to be statistically significant, are very encouraging. Certainly the indications seem to be that the results of supervoltage radiation in treatment of cancer of the tongue, as far as ridding the patient of his tumor are concerned, are at least as good as the results of treatment with 200-kv. radiation when comparable cases are considered.

The second type of tumor to be discussed is carcinoma of the tonsil, in which group there was more or less random division of patients between 200-kv. and supervoltage radiation. Of 28 patients treated with supervoltage radiation, 9 (32 per cent) had survived three years or more after treatment; whereas of 28 patients treated with 200-kv. radiation, only 5 (18 per cent) were alive after that length of time. Of 21 receiving supervoltage therapy who were followed five years or more, 5 (24 per cent) survived in contrast to 1 out of 18 (6 per

[2] 1,200–1,500 kv., at Massachusetts General; 1,000 kv. at the C. P. Huntington.

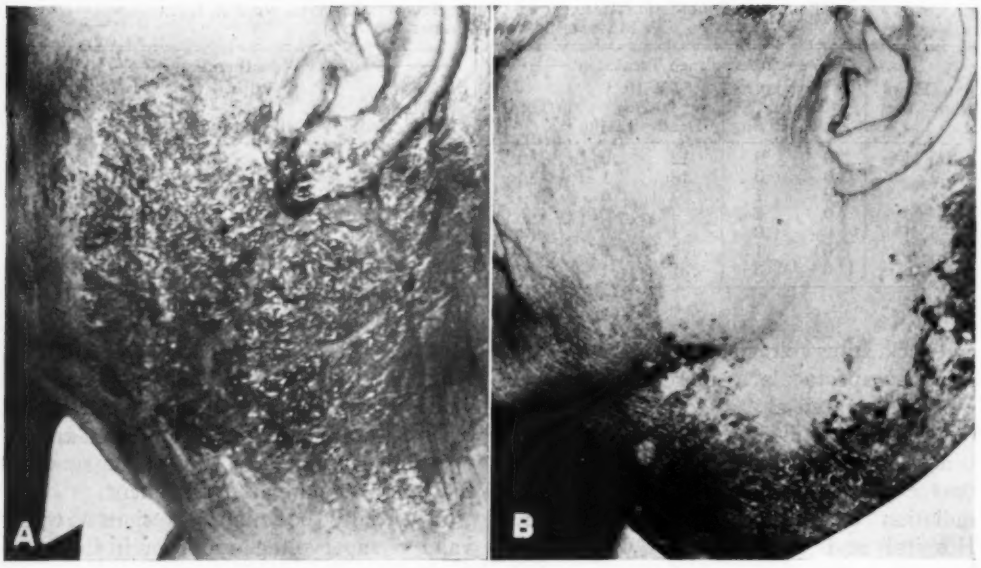


Fig. 1. A. Radiation reaction 2 weeks after treatment. A tumor dose of 6,000+ r was given to the tonsil with 1,200-kv. therapy, through a single 10 × 10-cm. lateral portal at 70 cm. skin-target distance. B. Six months after treatment.

TABLE II: COMPARISON OF RESULTS OF SUPERVOLTAGE AND HIGH-VOLTAGE THERAPY IN CARCINOMA OF THE TONSIL

Years Survived	Supervoltage Therapy		High-Voltage Therapy	
	No. Cases*	Survival	No. Cases*	Survival
3	28	9 (32%)	28	5 (18%)
5	21	5 (24%)	18	1 (6%)

* With opportunity to survive.

cent) of those treated with 200-kv. radiation (Table II). Though the over-all results seem to indicate that there was a definite clinical advantage in the treatment of cancer of the tonsil with supervoltage radiation, this may be more apparent than real and due to difference in tumor doses. The average tumor dose given those patients treated with supervoltage radiation was somewhat less than 5,000 r, while tumors treated with 200-kv. x-rays in the earlier years rarely received 3,000 r and often less. In more recent years the amount of radiation delivered into the tonsillar region by 200-kv. technic has approached or equaled that given with supervoltage therapy, and during this period the discrepancy in survival rates of the two technics has been less marked (10).

Even though the use of supervoltage x-rays does not in itself appear to give the patient with malignant disease in the head and neck any strikingly greater chance of being cured of his tumor than does 200-kv. x-ray irradiation—at least as it has been employed up to the present time—it offers him certain other definite advantages. These have to do principally with the factors which enable the radiologist to reduce the amount of damage to the normal structures about the tumor-bearing part while still delivering the desired dose to the tumor. The sparing action on the skin in supervoltage ranges is well known and is probably the most important feature of this technic. The threshold erythema is about 1,000 r at 1,000 kv. and about 2,000 r at 3,000 kv., when the radiation is delivered in a single dose. When the treatment is protracted and given at the rate of 300 r per day, an erythema appears when a total dose of somewhat less than 2,000 r has been reached with 1,000-kv. radiation, and after about 5,000 r in the 3,000-kv. range (8). If 1,200-kv.

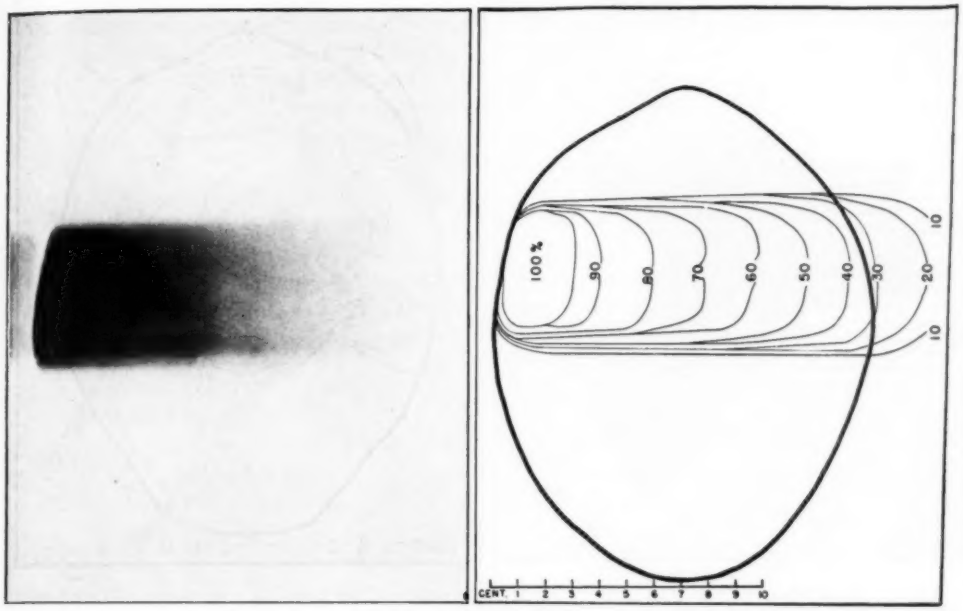


Fig. 2. Depth dose determinations in a composite phantom mannikin at the level of the tonsil. A single 5 × 5-cm. lateral portal of entry was employed at 100 cm. distance; h.v.l. 6 mm. Pb. (Used with the permission of John G. Trump, Sc.D., Department Electrical Engineering, Massachusetts Institute of Technology.)

radiation is used, doses of 5,000 to 6,000 r can be delivered to a tumor lying 5 to 8 cm. beneath the surface within a period of four weeks, through a single portal of entry, and the reaction of the skin will be no more brisk than is customarily seen when the skin is subjected to 4,000 r in a similar period of time using x-ray beams having a half-value layer of 1.0 mm. copper (Figs. 1 and 2). If cross-firing technics are used, the dose to the skin can be further reduced (Fig. 3).

If the multiple-field technic is carried to its ultimate extreme, that is, continuous rotation, a sharply circumscribed and very localized dose can be given to a tumor, in the tonsil for example, which is as much as five times that which the superficial tissues receive (Fig. 4). In this way, doses far in excess of what may be required to control the tumor can be administered. Even doses which would cause irreparable damage to the immediately adjacent normal structures can be delivered without producing more than a minimal reaction on the skin surface (7). This method may have some attraction for those radiologists who would like to treat cervical lymph node metastases with x-rays. It seems quite likely that doses into the tumor-bearing lymph nodes in the neck comparable in both size and circumscription to those produced by the implantation of interstitial radium can be delivered by this technic.

In this respect, a word of caution may be interjected. If the radiologist treats lesions with supervoltage radiation, he must keep the *tumor dose* constantly in mind. If he uses as his criteria for termination of a course of radiation those old signs (skin reactions) which are valid when treating in the 200-kv. range, he is bound for serious trouble. Even when the tumor dose is kept within what are commonly accepted as safe limits, untoward effects upon normal structures adjacent to the tumor are not always avoided with supervoltage therapy.

As previously stated, the increased depth dose available when supervoltage radiation is used is not as important when treating

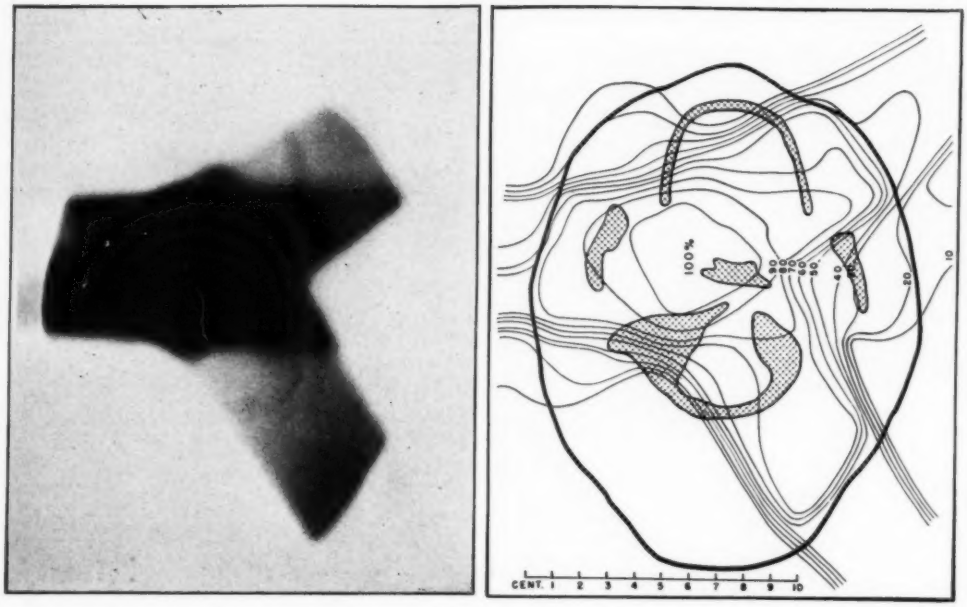


Fig. 3. Depth dose determinations by cross-firing the region of the tonsil in a composite phantom mannikin. Three 5 × 5-cm. fields placed 180° apart at 100 cm. skin-target distance were used; h.v.l. 6 mm. Pb. (Used with the permission of John G. Trump, Sc.D., Department Electrical Engineering, Massachusetts Institute of Technology.)

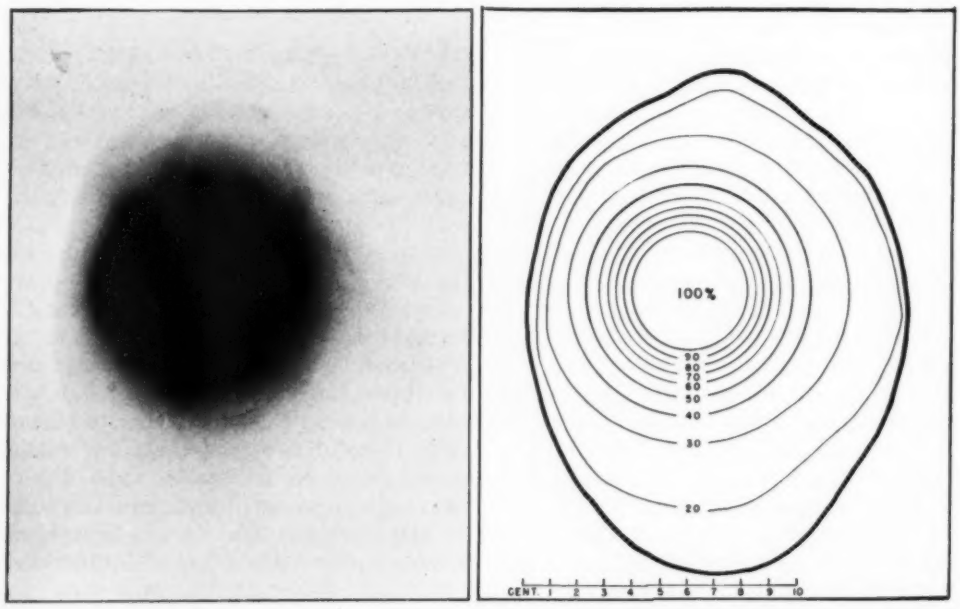


Fig. 4. Depth dose determinations in a composite phantom mannikin at the level of the tonsil, employing continuous rotation technic; 5 × 5-cm. field, 100 cm. skin-target distance, h.v.l. 6 mm. Pb. Note that at about 3 cm. from the center of rotation the dose falls to 70 per cent, and at the skin surface the maximum dose is only about 20 per cent of that which the tumor receives. (Used with permission of John G. Trump, Sc. D., Department Electrical Engineering, Massachusetts Institute of Technology.)

about the head and neck as it is in more massive parts of the body. If, however, these tumors are relatively small and well circumscribed, they lend themselves to careful localization within very small x-ray beams. Whereas the depth dose at lower voltages falls off rapidly with diminution in field size, as the voltage increases the relative diminution in depth dose with reduction in field size becomes less pronounced (Fig. 5). This, together with the fact that the intensity gradient toward the periphery of the field remains quite constant even when the smallest portals are utilized, is a definite advantage to be found in supervoltage radiation and one that is not available at lower voltages (see Fig. 2). The patient's normal tissues can be spared to a greater degree while the tumor dose remains adequate.

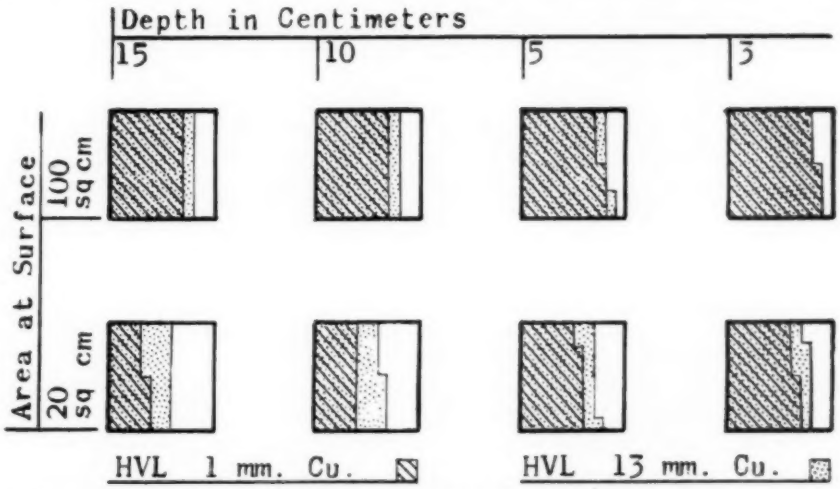


Fig. 5. Demonstrating the relative doses at various levels with fields of different size at 200 and 2,000 kv., in terms of per cent of the dose delivered through a portal of entry of 400 sq. cm. Note that in the supervoltage range it is less necessary to use large portals of entry in order to maintain a useful dose in the deeply buried tumor than it is in the 200-kv. range.

Another desirable factor, seemingly not widely appreciated, is the relatively negligible differential absorption of beams of supervoltage x-rays when passing through tissues of different densities. In the supervoltage range, the absorption of x-rays is less dependent upon the atomic number than in the lower therapeutic ranges, and accordingly lesser account need be taken of the intervening masses of bone when determining tumor doses by reference to standard tables derived from the use of homogeneous phantoms. This factor may be of considerable importance when the beam passes through the relatively dense bones of the skull, where the effect of the depth dose in ordinary high-voltage therapy has sometimes been greater than was realized (Fig. 6).

The problem of necrosis of bone and cartilage and of deterioration of the teeth when heavy irradiation about the head and neck has been attempted has always been, and still is, a serious one. Because absorption and scattering of x-rays in the supervoltage range are less dependent upon the atomic number than in the lower voltage ranges, there should theoretically be a lesser relative increment of scattered radiation in the region of the bone when supervoltage therapy is used. Innes (3) was able to measure only 2 per cent contribution by bone to the million-volt beam of x-rays in the depths of the tissue, whereas at 250 kv. he found an increment of 70 per cent. This fact should favorably affect the occurrence of the disheartening radionecrosis of the jaw which too often follows radiation therapy about the mouth. In our experience,

however, it has been no guarantee against this complication, especially when the bone is already exposed and infected and when the lethal dose to the tumor exceeds that tolerated by adjacent structures. Although experience with supervoltage radiation does not seem to have reduced the occurrence of unfortunate effects of radiation on the teeth and jaws, it is hoped that by meticulous attention to proper oral hygiene, by preparation of the mouth prior to the institution of treatment, which probably means removal of the teeth and allowance of sufficient time for healing, and by the proper use of antibiotics, the tissue-sparing action of supervoltage radiation may become more apparent.

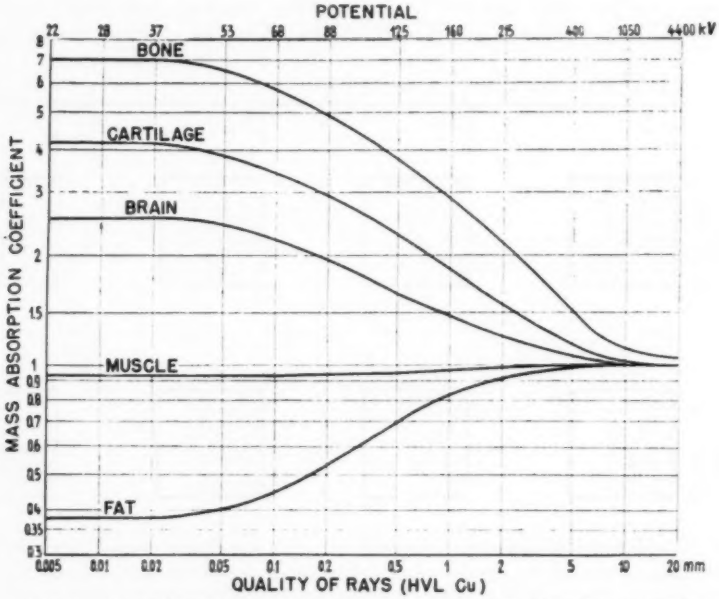


Fig. 6. Mass absorption coefficient. This illustrates the point that, as voltage increases, the differential absorption by tissues of different densities becomes less pronounced. (Adapted from Wachsmann, 9).

SUMMARY

Supervoltage x-ray therapy has become an established procedure in the treatment of cancer about the mouth and throat as in cancer elsewhere in the body. Its clinical advantages in this region are probably not manifest to the same degree as in those parts where the tumor lies more deeply buried. The over-all results, so far as ridding the patient of his disease are concerned, have not been notably improved by supervoltage irradiation, but the facility with which it can be done has been increased, and the damage to the patient while accomplishing the destruction of the tumor has been lessened.

From the physicist's point of view, there are a considerable number of advantages in treating malignant tumors with x-rays generated at supervoltage levels. From the patient's point of view, supervoltage has the advantage of sparing him to a limited degree some of the undesirable effects of radiation. From the clinician's point of view, supervoltage radiation offers another tool with which he can attack malignant neoplasms with a little greater nicety than before but probably with no remarkable increase in success—success being dependent on the radiotherapist's skill and experience in the use of the agent rather than on refinements of the agent itself, all

other things being equal. From the point of view of the tumor, there is little to indicate that in the range of therapeutic x-rays commonly available it cares greatly at which potential the x-ray that falls upon it is generated.

Massachusetts General Hospital
Boston 14, Mass.

REFERENCES

1. CANTRIL, S. T., AND BUSCHKE, F.: Clinical Usefulness and Limitations of Supervoltage Roentgen Therapy. Radiology **53:** 313–327, 1949.

2. HOLMES, G. W., AND SCHULZ, M. D.: Supervoltage Radiation. Review of the Cases Treated During an Eight Year Period (1937–1944 Inclusive). Am. J. Roentgenol. **55:** 533–554, 1946.

3. INNES, G. S.: Report from the Mozelle Sassoon Department, St. Bartholomew's Hospital, London. The Million-Volt X-Ray Plant: Its Development and Application. Proc. Roy. Soc. Med. **41:** 691–703, 1948.

4. LEUCUTIA, T.: Comparative Value of Deep and Supervoltage Roentgen Therapy. Statistical Analysis of Five Year Results in Selected Groups. Am. J. Roentgenol. **58:** 347–355, 1947.

5. NEWELL, R. R.: Quality of Radiation in Roentgen Therapy. Carman Lecture. Radiology **48:** 215–231, 1947.

6. SCHULZ, M. D., AND TRUMP, J. G.: Supervoltage Radiation. Chapter in Therapeutic Radiology, U. V. Portmann, editor, New York, Thomas Nelson & Sons. In press.

7. TRUMP, J. G.: Unpublished data.

8. TRUMP, J. G.: Physical Basis for the High Skin Tolerance of Supervoltage Roentgen Rays. Radiology **50:** 649–654, 1948.

9. WACHSMANN, F.: Ausblick auf die Anwendungsmöglichkeiten der Elektronenschleuder in der Medizin und bisherige Versuchsergebnisse mit ultraharten Strahlungen. From the University Clinic of Professor K. Matthes, Erlangen, and the Laboratory for Electromedicine of the Siemens-Reiniger-Werke. Read before the Northern Roentgen Congress in Stockholm, June 10, 1949.

10. WALKER, J. H., AND SCHULZ, M. D.: Carcinoma of the Tonsil. Review of Treatment and Its Results in a Group of Ninety Cases. Radiology **49:** 162–168, 1947.

SUMARIO

La Roentgenoterapia de Supervoltaje en el Cáncer de la Boca y la Garganta

La roentgenoterapia de supervoltaje se ha convertido en procedimiento establecido para el tratamiento del cáncer en la boca y la garganta, lo mismo que en otras partes del cuerpo. Sus ventajas clínicas en esta región no son probablemente tan manifiestas como en otras zonas en las que el tumor se halla enterrado más profundamente. Los resultados globales, en lo tocante a desembarazar al enfermo de su dolencia, no han mejorado mayor cosa con la irradiación a supervoltaje, pero sí ha aumentado la facilidad con que puede aplicarse la terapéutica a la par que han disminuído las lesiones experimentadas por el paciente mientras se logra la destrucción del tumor.

Desde el punto de vista del físico, hay muchas ventajas en tratar los tumores malignos con rayos X generados a intensidades de supervoltaje. Desde el punto de vista del enfermo, el supervoltaje posee la ventaja de ahorrarle en forma limitada los efectos contraproducentes de la radiación. Desde el punto de vista del clínico, la irradiación de supervoltaje aporta otra arma con que atacar las neoplasias malignas con alguna delicadeza mayor, pero probablemente sin mayor aumento del éxito, el cual depende, en igualdad de circunstancias, de la destreza y experiencia del radioterapeuta en el empleo del agente mismo. Desde el punto de vista del tumor, hay poco que indique que, dentro de los límites de los rayos X terapéuticos habitualmente disponibles, le concierna mucho a qué potencial se generan los rayos que le asestan.

Surgical Management of Cervical Lymph Node Metastases[1]

GRANTLEY WALDER TAYLOR, M.D.

Boston, Mass.

EVERY CASE OF malignant neoplasm about the head and neck must be evaluated in regard to possible metastasis to cervical lymph nodes. Since clinical diagnosis of early metastatic involvement is inaccurate, estimation of the probability of the presence of metastases must be based in part upon the characteristics of the primary tumor. In addition to the known behavior of the particular neoplasm in regard to node metastasis, characteristics apparently associated with the likelihood of its occurrence are location, size, duration, grade of malignancy, gross type of growth, and previous unsuccessful attempts to achieve control of the primary lesion. When these factors are evaluated, a fairly successful estimation can be made of the probable presence of metastases, even when node involvement is not clinically obvious.

The fallibility of depending upon the clinical estimate of lymph node metastasis is illustrated in Table I, demonstrating the size of cervical lymph nodes in relation to actual metastatic involvement secondary to carcinoma of the lip.

Obviously a small percentage of cases of cancer of the lip harbor metastases even when they cannot be detected clinically, and the larger the lymph nodes, the greater is the likelihood of metastasis. Even some large nodes, however, may be due to simple hyperplasia and inflammation.

Table II illustrates the relationship of the characteristics of the primary carcinoma of the lip to the occurrence of metastases.

Similar studies of carcinoma in other sites show equivalent results. In some regions, as for example the tongue and floor of the mouth, due to a rich lymphatic plexus and the muscular activity of the part, the over-all propensity of tumors to form metastases is much greater than with lesions of the lip. Conversely, carcinomas situated over bony surfaces, as the hard palate and the gingiva, where they are not subjected to muscular activity, have a lessened likelihood of lymph node metastasis.

TABLE I: CARCINOMA OF LIP: SIZE OF CERVICAL LYMPH NODES

Size of Nodes	No. of Cases	Per cent Positive
Not palpable	163	8.5
Less than 1 cm.	63	9.5
1–2 cm.	57	67.0
Over 2 cm.	23	91.0

TABLE II: CARCINOMA OF LIP: CHARACTERISTICS OF PRIMARY LESION

Primary Lesion	Per cent with Metastases
Short duration	14
Long duration	33
Low malignancy	6
High malignancy	52
Small	7
Large	37
Primary	29
Recurrent	64

The problem of treatment must be divided into two parts, that of the primary carcinoma and that of the node metastases. Before treatment of the nodes is undertaken, the primary carcinoma must have been controlled, or must be obviously controllable. If the primary lesion is uncontrollable, only palliative measures are indicated.

Following control of the primary carcinoma, the decision must be made whether any treatment is necessary to the regional lymph node areas. This will depend upon

[1] Presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

[2] Asst. Clinical Professor of Surgery, Harvard Medical School; Visiting Surgeon, Massachusetts General Hospital and Pondville State Cancer Hospital; Chairman, Cancer Committee, American College of Surgeons.

TABLE III: NECK DISSECTION; LIP LESION CURED

	No. of Cases	Per cent Positive Nodes	Per cent Positive Nodes Cured
Primary cases			
Nodes not palpable	151	10	60
Nodes clinically benign	90	27	80
Nodes clinically involved	85	36	55
Delayed dissections	17	70	33
Secondary cases	28	71	50

the presence of obvious metastases or the probability of the development of metastases. A policy of watchful waiting may be justified if obvious metastases are not present, and if there is not much likelihood of the later development of metastases, provided very careful follow-up observations can be carried out. It should be realized, however, that delay involved in waiting for obvious metastasis may diminish the chance for cure, although it reduces the number of "unnecessary" operations.

Regional lymph node dissection is undertaken for clinically obvious metastases, provided that they are not inoperable because of extent and fixation; and also when there is a high degree of probability of metastasis. The extent of dissection is based on the zones of lymphatic drainage involved. For prophylactic dissection in cases of carcinoma of the lip and inside cheek we have considered the supra-omohyoid dissection adequate in extent. For carcinoma of the tongue and floor of the mouth, salivary glands, and thyroid, and malignant melanoma about the head and neck, we have carried out radical neck dissections. As a rule, these dissections are performed two to six weeks after treatment of the primary lesion has been carried out.

In evaluation of the efficacy of dissection for involved lymph nodes, we have limited our study to the cases in which the primary carcinoma was controlled. When those cases are ruled out in which failure was attributable to local recurrence, and when only the cases with proved metastatic involvement are considered, it is evident that proper radical dissections result in a gratifying number of cures.

TABLE IV: DISSECTIONS FOR POSITIVE NODES

Primary Cancer Cured	Dissections	Cures
Lip	100	58%
Tongue	46	43%
Mouth (other parts)	39	38%

In recent years there has been renewed interest in one-stage *en bloc* operations, combining dissection with direct attack on the primary carcinoma, by division or partial resection of the mandible. These operations have been made safer by modern methods of anesthesia and especially by the use of chemotherapy and antibiotics. Many cases formerly considered inoperable may be subjected to these very radical operations, and additional cures will probably result. It is premature to attempt critical evaluation of these procedures so far as cures are concerned.

264 Beacon St.
Boston 16, Mass.

SUMARIO

La Asistencia Quirúrgica de las Metástasis en los Ganglios Linfáticos Cervicales

Antes de emprender la disección de las metástasis de los ganglios cervicales, tiene que haberse cohibido el carcinoma primario o debe ser el mismo manifiestamente cohibible. En caso contrario, sólo están indicadas las medidas paliativas.

La disección de los ganglios linfáticos regionales se emprende en caso de metástasis clínicamente manifiestas, con tal que no sean inoperables debido a su extensión y fijación, y también en los casos en que es muy probable la existencia de metástasis.

En 100 casos de cáncer del labio en que se curó la lesión primaria y había metástasis ganglionares, la disección logró curaciones en 58 por ciento; para 46 casos de cáncer de la lengua la cifra fué de 43 por ciento y para 39 de otras partes de la boca de 38 por ciento.

Treatment of Cervical Lymph Node Metastases with Irradiation Alone[1]

CHARLES L. MARTIN, M.D.

Dallas, Texas

In 1933 Fischel (1) wrote: "My own experience with both irradiation and operation has led me to believe that reports of lasting favorable results from irradiation of metastatic glands have been based upon the effect of irradiation on palpable hyperplastic glands and not upon true metastases." Most good surgeons since that time have accepted Fischel's pronouncement without question and one frequently encounters the statement that block dissection offers the only chance of cure after metastases appear in the lymph nodes of the neck. In the author's opinion this statement is untrue, and the present paper is written as a refutation of the position assumed by our surgical confreres.

If block dissection produced a high percentage of cures, the development of other methods would hardly be worth while, but a perusal of the published statistics indicates that the method leaves much to be desired. The evaluation of any procedure used in the treatment of cancer should be based on absolute statistics, but such figures are conspicuously absent in published surgical reports. Brown and McDowell (2) have tabulated some of the more reliable figures for proved operable cases, as set down in Table I. From this material it seems fair to assume that approximately 25 per cent of the more favorable operable cases are cured by block dissection. The estimation of an accurate absolute figure is very difficult, but data assembled in previous articles (3, 4) indicate that it probably does not exceed 15 per cent. Since the radiologist must eventually treat at least 75 per cent and more—probably some 85 per cent—of the patients coming to tumor clinics with cervical lymph node metastases, any effort aimed at the improvement of irradiation technics is fully justified.

Table 1: Results of Neck Dissection for Metastatic Carcinoma (Brown and McDowell)

Author	Patients Treated	Patients Well 5 Years	Primary Lesion
Duffy	45	9 (20%)	Mouth
Morrow	26	3 (11%)	Tongue
Fischel	48	17 (35%)	Mouth and lip
New	57	8 (14%)	Tongue
New	50	18 (39%)	Lip
New	45	11 (24%)	Jaw
Martin, H.	65	17 (26%)	Mouth and lip
Blair and Brown	74	20 (27%)	Mouth
Totals	410	103 (25%)	

RADIOLOGICAL TECHNICS

The surgical literature contains many justifiable criticisms of external irradiation delivered with radium collars, radium bombs, and x-ray therapy. Although these methods have effectively controlled node metastases secondary to transitional-cell carcinomas of the pharynx in a selected group of cases, they have produced no conclusive five-year cures of nodes containing squamous-cell carcinoma. In the author's opinion the dose needed to control squamous-cell carcinoma growing in lymph nodes is considerably larger than that needed to eradicate the primary neoplasm, and with the technics now available the skin and subcutaneous tissues cannot withstand the entire massive irradiation needed for complete destruction of the malignant tissue in the underlying nodes. In 1931 Quick (5) described a plan for delivering the necessary large dose by augmenting the local effect produced by implanted radon seeds with externally applied x-rays generated at 200 kv. He adopted this pro-

[1] Presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

cedure because work done in Quimby's laboratory (6) had shown that larger amounts of radiation could be safely administered to the skin with this combined method than with either x-rays or gamma rays alone. Hayes Martin and Sharp (7), after trying out this technic, published the following statement later in 1931: "After several years of experience with block dissections of the neck, we believe that implantation with gold seeds offers equally good end-results in operable cases, without the operative risk of the major surgical procedure." The details of the technic as it was finally perfected were published by Hayes Martin, Munster and Sugarbaker (8) in 1940. External x-ray irradiation was given through small circular ports (3 to 5 cm. in diameter) to each separate node. Depending on the size of the port, 4,000 to 8,000 r were given in daily divided doses over a period of two to three weeks. Immediately on the completion of this external dose, radon seeds, for a tissue dose of 5 to 10 skin erythema doses, were implanted either through puncture wounds in the skin or after surgical exposure of the outer surface of the node. In 1941, five-year cures were reported in 46 cases of proved squamous-cell carcinoma of the cervical nodes as positive proof of the value of this combined technic (Hayes Martin, 9).

Watson (10) has attacked the problem in a different manner by applying a large single dose of x-rays (at least 50 per cent more than the skin will tolerate) to the node-bearing area after the cutaneous tissues have been reflected at operation. However, he regards this method as a palliative procedure and reports no five-year cures. Evans and Griffith (11) have implanted low-intensity radium needles alone throughout the involved lymphatic bed but, as would be expected, they have reported no lasting good results. Cade (12) also uses low-intensity radium needles but advises that preliminary x-ray therapy be given, in doses not to exceed 3,000 r. He also states that teleradium constitutes the method of choice but gives no statistics to support this contention.

Paterson (13) claims that he has found irradiation therapy of little or no value in the treatment of cervical lymph node metastases. Since his opinion is based on the administration of 6,000 gamma roentgens with (*a*) interstitial sources or radium molds and (*b*) the use of x-rays applied externally, to skin tolerance, without added interstitial radium, his lack of enthusiasm is understandable.

Although the technic advocated by Quick, Hayes Martin, and their collaborators produces good results, its weakness appears to lie in the poor distribution of radon seeds, which tends to place the effective doses in relatively small areas. A more uniform distribution of gamma rays over larger areas can be obtained with implanted low-intensity radium needles and, since they give off no beta rays, the factor of safety is somewhat higher. Since the insertion of needles through heavily irradiated skin is unpleasant for the patient, we have adopted the plan of administering the x-ray therapy after the implantation has been carried out. As a rule, it is possible to use a planar pattern designed to irradiate the lymphatic bed efficiently well beyond the involved nodes. The low-intensity needles are left in place for seven days and are so spaced that they deliver doses ranging between 12,000 and 6,000 gamma roentgens to the implanted subcutaneous tissues. These doses are calculated from a simple chart published in a recent article (14). On the day after the radium is put in place, the x-ray therapy is started and daily doses of 350 r measured in air are given up to a total of 2,100 r. The treatment factors are 220 kv., a target-skin distance of 50 cm., a Thoræus filter (0.4 mm. of tin), and a tube current of 20 ma. The portal, which is centered over the palpable nodes, rarely exceeds 10 × 15 cm. The x-ray dosage is considerably smaller than that used by Quick because it is given simultaneously with the radium therapy. The entire procedure is carried out in one week, and the economy of time is worthy of consideration.

A deep erythema appears on the skin of

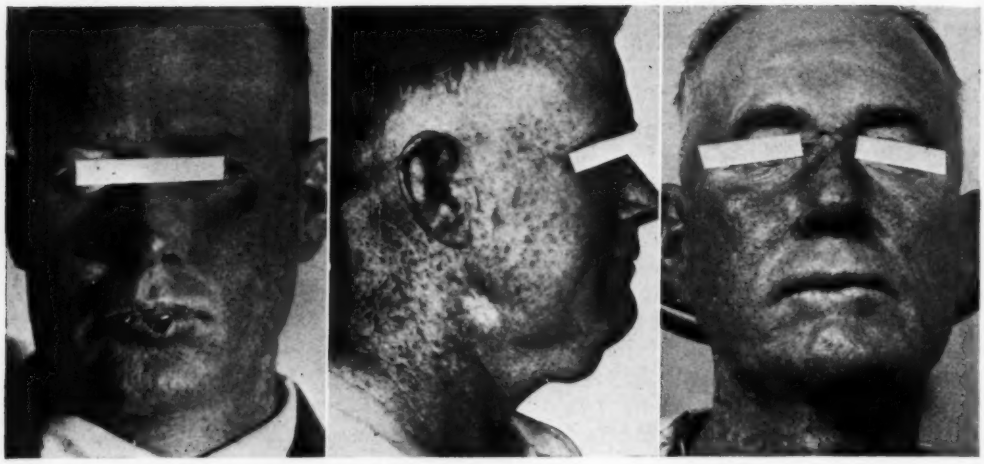


Fig. 1. Large submental nodes which appeared several years after the complete regression of a squamous-cell carcinoma of the lower lip following x-ray therapy, cured by combined x-ray and low-intensity radium needle technic. The photograph on the right was made fourteen years after the treatment was given.

the neck about ten days after the treatment is finished, and as a rule a complete denudation of the superficial layers occurs soon afterward. This reaction does not produce marked discomfort when treated with daily applications of boric acid ointment. A mild soreness in the throat and some difficulty in swallowing may appear at the same time but soon clear up. The treated surface heals in six to eight weeks, leaving some scarring and atrophy, and later a soft fibrosis appears in the subcutaneous tissues. Telangiectasis may become noticeable after several months in the base of the neck but is rarely observed in the upper portion. When large areas are treated in advanced cases, the scarring sometimes produces discomfort with sharp weather changes but causes little or no interference with function.

In a few cases the combined technic has been attempted following a block dissection, with the needles concentrated in the areas where the surgeon believed he might have been unable to remove deep-seated malignant tissue. This procedure has been abandoned because of the poor healing observed in the operative wounds, and all needles are now inserted through small skin incisions made with a pointed scalpel. In the beginning, an attempt was made to treat the upper neck on the involved side at the same time that intraoral lesions were implanted as a prophylactic measure, when no nodes were palpable. In many patients treated in this manner tissue necrosis and necrosis of the mandible developed, necessitating a removal of the damaged bone at a later date, and this method has also been discontinued. We now believe that the neck should be treated only when nodes are palpable and only after the primary lesion has been eradicated.

RESULTS

The first patient to receive the type of therapy described above was treated in 1935 and he is still alive and well. Two large nodes appeared in the right submental area about one year after the successful treatment of a cancer of the lower lip. Although no biopsy studies were done on these nodes, they contained a cheesy material when punctured and in the author's opinion were undoubtedly malignant. Because of the good result obtained in this case, the method was adopted as a routine procedure in 1937, and 146 patients with palpable cervical nodes clinically diagnosed as metastatic from carcinoma of the face, neck, and mouth were treated prior to

Fig. 2. Appearance of the neck two and eight years after the treatment of enlarged upper cervical nodes with a combined x-ray and low-intensity radium needle technic. The diagnosis of squamous-cell carcinoma was made from biopsy studies of a node removed surgically.

March 1944. More than 300 cases have now been treated and will be available for study at a later date. After a rapid extension of metastases in the neck was observed following the surgical removal of single nodes for biopsy studies in several instances, this procedure was discontinued, but during recent years needle biopsies, which seem to be relatively safe, have been done. Since the adoption of this plan, our clinical diagnoses have been proved correct in such a high percentage of cases examined that we feel that the results obtained in the 146 cases treated more than five years ago (Table II) are worthy of consideration. A careful survey of this group reveals that 40 patients, or 27.3 per cent, were alive and well for five or more years from the time of treatment. Since every patient entering our clinic was included in the series, the figures reported are absolute and, even though a few of the diagnoses might have been incorrect, the cure rate of 27.3 per cent compares favorably with the average of 25.0 per cent reported by Brown and McDowell for a group of selected operable cases submitted to block dissection.

Many of these cases were well advanced, and the palliative value of the radiation technic is of interest. Although the follow-up studies were not complete, the observation was made that the palpable nodes regressed so that they were no longer palpable in 102, or 70 per cent, of the 146 patients treated.

Surgeons who have seen and examined

TABLE II: END-RESULTS IN ALL PATIENTS WITH CERVICAL NODE METASTASES TREATED WITH IRRADIATION, 1937–1944

Primary Lesion	Number of Cases	Patients Living and Well							Well Five or More Years
		11 Years	10 Years	9 Years	8 Years	7 Years	6 Years	5 Years	
Lip	50	...	2	4	1	1	...	6	14
Internal surface of cheek	26	...	1	...	...	...	2	3	6
Tongue	27	...	...	1	...	...	1	2	4
Face and neck	20	...	1	...	...	...	2	3	6
Floor of mouth	3	1	...	...	...	1	...	...	2
Ear	4	...	1	...	...	...	...	1	2
Alveolus	4	...	...	...	...	...	...	1	1
Undetermined	6	...	...	...	...	1	3	...	4
Soft palate	3	...	...	...	...	...	...	1	1
Tonsil and pharynx	3	...	...	...	...	...	...	...	0
TOTALS	146	1	5	5	1	3	8	17	40 (27.3%)

TABLE III: METASTATIC SQUAMOUS-CELL CARCINOMA IN CERVICAL LYMPH NODES, HISTOLOGICALLY PROVED, TREATED RADIOLOGICALLY

Primary Lesion	Number of Cases	Living and Well					Well Five or More Years
		10 Years	9 Years	7 Years	6 Years	5 Years	
Lip	11	...	1	1	...	2	4
Face	2	1	...	...	...	...	1
Undetermined	4	...	...	1	3	...	4
Totals	17	1	1	2	3	2	9

the patients reported in this paper are convinced of the value of the radiation technic, but those who hear of it for the first time are likely to contend that the nodes which regressed contained no carcinoma. Table III was prepared as positive evidence that metastatic nodes not only may be made to disappear but that the patients so treated may remain well for periods of five to ten years. In each of the 17 cases reviewed, squamous-cell carcinoma was demonstrated by needle biopsy of a node or by the surgical removal of tissue. No block dissections were carried out in this series or in any of the cases reported in Table II. On certain occasions, surgeons have admitted that the method might possibly control the smaller nodes but have expressed doubt relative to its effectiveness in the treatment of larger ones. As might be expected, the prognosis is better when the nodes are small, but the figures set down in Table IV show that satisfactory regression was obtained with some larger nodes as well.

TABLE IV: SIZES OF LYMPH NODES IN NINE PATIENTS WITH PROVED METASTASES WELL FIVE YEARS AFTER IRRADIATION

Size of Largest Node (cm. diameter)	Number of Cases
2.5	4
3.5	1
4.0	1
5.0	2
6.5	1

With an effective method of treating cervical metastases available, an absolute cure rate of 27.3 per cent seems rather unsatisfactory. The Bureau of Vital Statistics provided death certificates for 91 of the 146 patients reported in Table II known to be dead, and we were surprised to learn that

TABLE V: CAUSES OF DEATH OF PATIENTS WITH LYMPH NODE METASTASES TREATED FIVE OR MORE YEARS AGO

Total Cases	91
Dead of cancer treated	46
Dead of other causes	45
Unknown cause	9
Heart disease	2
Cerebral hemorrhage	3
Nephritis	2
Pneumonia	4
Cirrhosis of liver	1
Cancer of prostate	1
Cancer of larynx	1
Cancer of colon	1
Metastases	
Pulmonary	10
Liver	1
Bone	4
Brain	4

death was directly attributed to cancer of the head and neck in only about half of them (Table V). Primary cancer in other locations produced the fatal outcome in 3, and 12 others succumbed to the intercurrent diseases commonly observed in the older age groups. In 19 death resulted from distant metastases. Since at least two-thirds of the women with axillary metastases from cancer of the breast die of internal extension after the nodes have been completely removed, it is reasonable to assume that some of the neck cases will be lost in the same manner even when the nodes are completely eradicated. It seems unlikely, therefore, that the salvage will be materially improved by either block dissection or radiological methods until patients are induced to apply for treatment before the disease is well advanced.

SUMMARY

Evidence is presented to prove that metastatic cervical lymph nodes secondary to squamous-cell cancer of the head, neck, and mouth can be eradicated by a combina-

tion of interstitial radium therapy and external x-ray therapy applied simultaneously during a period of seven days. A statistical survey of a series of 146 cases diagnosed clinically and treated with this technic five or more years ago suggests that the salvage falls in the same range as that reported for block dissection.

3501 Gaston Ave.
Dallas, Texas

REFERENCES

1. FISCHEL, E.: Surgical Treatment of Metastases to Cervical Lymph Nodes from Intraoral Cancer. Am. J. Roentgenol. **29:** 237–240, 1933.
2. BROWN, J. B., AND MCDOWELL, F.: Treatment of Metastatic Carcinoma of the Neck. Ann. Surg. **119:** 543–555, 1944.
3. MARTIN, C. L.: Treatment of Metastatic Cervical Lymph Nodes with Irradiation: New Method. Tr. Sect. Laryng., Otol. & Rhin., A.M.A., pp. 86–108, 1940.
4. MARTIN, C. L.: Treatment of Metastatic Cervical Lymph Nodes: New Method. Texas State J. Med. **37:** 236–241, 1941.
5. QUICK, D.: Interstitial Radiation in Metastatic Nodes of Epidermoid Carcinoma. Ann. Surg. **93:** 380–390, 1931.
6. QUIMBY, E. H., AND PACK, G. T.: Skin Erythema for Combinations of Gamma and Roentgen Rays. Radiology **13:** 306–312, 1929.
7. MARTIN, H. E., AND SHARP, G. S.: Use of Gold Filtered Radon Implants in the Treatment of Intraoral Cancer. Am. J. Roentgenol. **26:** 28–38, 1931.
8. MARTIN, H. E., MUNSTER, H., AND SUGARBAKER, E. D.: Cancer of the Tongue. Arch. Surg. **41:** 888–936, 1940.
9. MARTIN, H. E.: Treatment of Cervical Metastatic Cancer. Ann. Surg. **114:** 972–985, 1941.
10. WATSON, T. A.: Subcutaneous X-Ray Therapy. Brit. J. Radiol. **16:** 113–114, 1943.
11. EVANS, W. G., AND GRIFFITH, H. D.: Dosage Control of Interstitial Radium Treatments by Direct Measurement of Skin Dosage-Rate. Brit. J. Radiol. **14:** 377–385, 1941.
12. CADE, S.: Malignant Disease and its Treatment by Radium. Baltimore, Williams & Wilkins Co., 2d ed., 1949, Vol. II
13. PATERSON, R.: The Treatment of Malignant Disease by Radium and X-Rays, Being a Practice of Radiotherapy. Baltimore, Williams & Wilkins Co., 1948.
14. MARTIN, C. L.: Low Intensity Radium Element Needles. Janeway Lecture. Am. J. Roentgenol. **62:** 467–492, 1949.

SUMARIO

Tratamiento de las Metástasis de los Ganglios Linfáticos Cervicales Exclusivamente con la Irradiación

Preséntanse datos demostrativos de que pueden erradicarse en los ganglios linfáticos cervicales las metástasis secundarias a cáncer escamocelular de la cabeza, cuello o boca, con una combinación de curieterapia intersticial y roentgenoterapia externa, aplicadas simultáneamente durante un período de siete días. Se implantan agujas de poca intensidad para entregar dosis que oscilen entre 12,000 y 6,000 roentgens gammas a los tejidos subcutáneos. La roentgenoterapia se inicia al día siguiente, administrándose dosis diarias de 350 r (al aire) hasta un total de 2,100 r (220 kv., 50 cm. de distancia foco-piel, filtro de Thoraeus, 20 ma.). El repaso estadístico de una serie de 146 casos diagnosticados clínicamente y tratados con dicha técnica hace cinco años o más reveló 40 enfermos, o sea 27.3 por ciento, vivos y sanos al cabo de cinco años o más, es decir, un coeficiente de curación que queda dentro de los mismos límites comunicados para la disección en bloque.

DISCUSSION

(Papers by Collins and Pool; Eberhard; Schulz; Taylor; Martin)

Richard H. Chamberlain, M.D. (Philadelphia, Penna.): I will confine my remarks largely to Dr. Eberhard's paper on tumors of the nasopharynx. Dr. Eberhard's presentation is a model of the correct attitude toward the analysis of a tumor for treatment and also of the physician's attitude toward his patient. It is also a model of presentation of material in a scientific meeting. There is an old saying that a lecture is the process by which the notes of the professor become the notes of the student without passing through either brain. Dr. Eberhard has beautifully demonstrated that it is possible to impart information so that it will be indelibly impressed upon the hearer's mind with a minimum of effort.

In radiotherapy of all tumors, but particularly of those in the nasopharynx such as we have seen here, the distribution of radiation throughout the volume of the tumor is most important. It seems to me that the radiologist of our day is under obligation to consider quite critically the pattern

and contour of the intensity of radiation that is delivered into a region. This can be done by either one of two rather tedious processes. Dr. Schulz has shown how it can be done by the direct measurement of radiation intensity in phantoms which are set up to simulate the individual situation. Another practical method involves making a plaster cast of the part to be treated, transferring the contours to tracing paper, superimposing standard isodose curves such as those prepared by Dr. Mayneord, and finally analyzing them mathematically to produce summation isodose contours.

I have chosen a slide from a current case of a squamous-cell carcinoma of the nasopharynx with widespread extension into the basisphenoid. Occipital portals were added because of the posterior extension. Heavy lines show the isodose contours of six cross-firing fields and the faint lines represent the summation isodose contours within the tumor area. These calculations are the result of approximately eight hours work on an individual case.

I do not think this procedure can be advocated in every case, for it is quite time-consuming, but the radiologist must think of his dosage in this fashion and he must do enough determinations of this type, particularly in difficult and unusual cases, to be familiar with the pattern of distribution produced.

William Harris, M.D. (New York, N. Y.): Since Dr. Quick's original publication on the "Management of Metastatic Lymph Nodes by Radiation," most of us have had the opportunity to use a combination of external and interstitial radiation, with success in some cases.

I do not question the fact that Dr. Charles Martin has obtained a number of cures in patients with metastatic cervical carcinoma. My objection to the use of radiation as a routine procedure in metastatic disease in the neck for the adult type of squamous-cell carcinoma is that one can never tell just how much involvement there is from a clinical examination. Metastatic nodes from the tongue, floor of the mouth, and the buccal mucosa very often involve the deep cervical fascial planes and they may occur anywhere from the base of the skull to the clavicle.

It is impossible, at present, to adequately irradiate with a cancerocidal dose the whole neck, because the volume of tissue is too great. Where cure has been attained, the lymph node involvement must necessarily have been limited in area. It is for this reason that I believe that, if the patient's condition will tolerate it, a radical neck dissection has more to offer as regards cure than the routine use of radiation therapy.

William E. Howes, M.D. (Brooklyn, N. Y.): My remarks will be limited to the paper of Dr. Collins and Dr. Pool.

From the standpoint of the pathological classification of malignant tumors arising in the maxillary antra, the squamous-cell carcinoma is the type by far the most commonly encountered. However, any of the other types of carcinoma which may arise in respiratory epithelium may occur. These would include the transitional-cell carcinoma and the adenocarcinoma, as well as that strange variant called the basal-cell carcinoma, which appears under the microscope much the same as those basal-cell tumors arising in the skin. Of necessity these growths are locked up in a bony box, the normal drainage from which is early blocked. As a result of poor antral drainage, infection enters in, favoring the more rapid spread of carcinoma, and our ability to cure the carcinoma is in turn made more difficult by the presence of infection.

I agree with the essayists that the combined attack with radiation and surgery is the best and really the only method of treatment. In our experience, breaking through the palate to enter the antrum, while it is a recommended procedure, has been fraught with complications. It is difficult to obtain a proper fitting dental plate, especially in the early stages, to fill the surgical defect so that the patient can get adequate nourishment without a great deal of difficulty. It has been my experience that the best approach, even in the more advanced cases, is through the cheek anteriorly, by a wide removal of the anterolateral wall of the antrum. Thus the radiologist can look directly into the antrum and can accurately plan his radium procedure as well as see more exactly the end-result without the use of mirrors. This has been our most favorable method of attack.

A further suggestion is not to put off exenteration of the orbit till late. If the surgeon delays, the disease will soon have progressed posteriorly into the cranium beyond ability to eradicate it. The surgeon is therefore urged to remove the eye along with the other orbital contents as soon as there is the slightest indication of the tumor having broken into the orbital fossa.

Robert R. Newell, M.D. (San Francisco, Calif.): I was very glad to hear a defense of the really radical approach to carcinoma of the antrum and really adequate irradiation. It seems very hard for us oftentimes to persuade our professional colleagues in the nose and throat service to do a sufficiently radical attack to begin with. They often feel that it is sufficient to make a hole in the cheek to let us put some radium in through it. I would not feel that a mere anterior window in the canine fossa is a sufficient way to let radium be used efficiently for the maxillary antrum.

I have been surprised to see a good many eyes live through heavy irradiation. One need not always decide that the eye has to be given up.

It was presented as a proposition that, if one has to fill more than a 6-cm. sphere with a cancerocidal dose of radiation, one ought to use radium in more than one place or that one ought to use external irradiation. In my opinion, the thing should be put in quite a different fashion, that if you have to fill more than a 6-cm. sphere with a cancerocidal dose in the case of the maxillary antrum, your patient can't bear it. That is why we don't use more than that dose of radium, *i.e.*, the patient can't live through it.

I would like to talk about Dr. Schulz' paper. On the whole, I don't believe that supervoltage is much better than standard 200-kilovolt x-ray. There are places, however, as in the head, where necrosis in the jaw, upper and lower, is a desperately damaging complication of sufficient irradiation treatment. One feels that in this region, therefore, since the absorption coefficient in bone more nearly approaches the absorption coefficient in flesh, supervoltage might offer a critical advantage.

One approaches a carcinoma of the lower lip with perfect confidence in irradiation. One cannot escape the feeling that if one could only get the same size dose adequately in all portions of the cancer in another part of the head and throat he would succeed in curing that, too. I do think oftentimes it is distribution, and the fact that the bony skeleton is in the way, which keep us from achieving a cure in another place.

I don't see why Dr. Martin felt he should be on the defensive just because he followed a magnificent set of statistics by Dr. Taylor. It seems to me Dr. Martin should take pride in a number of cases which he has cured of cancer, in which I for one would have said the patient had no chance. That seems to me a sufficient support for his method of attack even though I do not myself wish to give up the use of neck dissection in the treatment of cancer of the head and neck.

Donald M. Glover, M.D. (Cleveland, Ohio): This has been a most stimulating program, and as a surgeon I feel it a great privilege to have been permitted to hear the discussions that have been presented.

I agree whole-heartedly with Dr. MacComb,[1] that irradiation is generally the method of choice in the treatment of carcinoma of the floor of the mouth. I agree, also, that an occasional case will be better treated, when bone is secondarily involved, by the rather destructive type of surgical procedure which he has described. I feel, however, that such an operation is seldom justified. It is a very destructive procedure, but we are dealing with a very destructive disease. I feel that all of us have in some instances attempted those radical procedures, including radical neck dissections, in cases where the operation should not have been done and we merely hastened the dissemination of the tumor and probably shortened the life of the patient. Certainly, the cases must be very carefully selected, and only those with a real opportunity for cure subjected to this procedure.

On the question of prophylaxis of the mouth, I agree as to the extraction of teeth before irradiation is begun. In some instances where teeth are left in and subsequently become infected, very late necrosis may occur.

I have two slides which illustrate some points which I thought might be worth mentioning and which also illustrate points made by the speakers. The patient was a man of about forty-eight, who had carcinoma of the floor of the mouth which one year before the first slide was obtained was treated by interstitial irradiation. The primary lesion was about 2.5 cm. in diameter, to the right of the midline, and there was a 2.5-cm. submaxillary lymph node which was treated by interstitial irradiation. External irradiation was also given on that side of the neck. Supraomohyoid neck dissection was performed subsequently and it was found that the node in the right submaxillary region, which had been previously irradiated, was free from tumor, but a node in the left submaxillary triangle was involved. This finding, of course, bears out what Dr. Taylor said about the value of prophylactic dissection. It also bears out Dr. Martin's contention that it is possible to sterilize lymph nodes of tumor by irradiation alone.

About six months after the original treatment by irradiation, the mandible began showing evidence of necrosis, probably due to the effects of the cross-fire irradiation from treatment of the intraoral lesion and the submaxillary lymph node. The dangers of such treatment have been mentioned by several of the speakers today. At the end of nine months there was complete necrosis of the right mandible from the vertical ramus to the opposite canine region. It will be noted that a cervico-thoracic flap had been prepared and lined with skin for closure of the buccal fistula at the time of removal of the necrotic mandible.

There is some difference of opinion about when the sequestrated mandible should be removed. It is our feeling that it is wise to allow complete sequestration to take place in order that the bone may be removed at the line of demarcation with minimal damage to the adjacent bone, which remains viable. Bone grafts for replacement of the necrotic mandible must be done much later As a temporizing measure, we have used tantalum plate shaped on the operating table and impinged into the normal bone ends or wired to them, to prevent overriding of the remaining fragments. Such a procedure was used in the case we have described, the tantalum plate being covered with

[1] Dr. MacComb's paper not submitted for publication.

the lined cervico-thoracic flap which had been prepared previously. The tantalum plate may occasionally be left in place indefinitely.

The second slide shows the appearance of the patient after the cervico-thoracic flap was attached and the pedicle cut loose, the tantalum plate being covered by the flap.

A good deal has been said by the speakers today about the operative risk of neck dissection. I believe that risk is somewhat overemphasized. Dissection can be done quite readily under local anesthesia alone or a combination of local anesthesia and pentothal which permits a short period of recovery and usually about a week of hospitalization. It might be well to stress again the importance of a consistent plan of management of patients with intraoral carcinoma. A complete plan of treatment should be formulated at the outset, and whether irradiation alone is to be used, or surgery alone, or a combination of irradiation and surgery, that plan should be adhered to without deviation.

I am much impressed with the results reported by Dr. Martin. It is a great advantage if cervical nodes can be sterilized of cancer cells by the technic he has demonstrated. I believe, however, that surgical removal of the lymphatic drainage area is often preferable.

In conclusion, it seems that the aim of our treatment in oral carcinoma should be to get rid of the primary disease by either irradiation or surgery, using destructive therapy. We should not pull our punches and should not feel disappointed if we have complications from either method. We should, at the same time, attempt to leave the patient with minimal deformity.

Frank S. Gibson, M.D. (Cleveland, Ohio): It has been pleasant to hear the discussion of the two methods of approach to the treatment of cervical lymph node metastases as presented by Dr. Taylor and Dr. Martin. These methods alone or in combination constitute our only present defense against the fatal spread of cancer about the mouth, and the physician who is to be called upon to treat the disease should always consider the probability of early metastases.

I believe it is an admissible fact that cancer is primarily a local disease; at just what point in its development this is no longer true can rarely be determined. Certain it is that before the affected patient reaches a physician localization usually no longer exists. If this were not true, we would not be discussing our incidence of five-year cures, for complete destruction of the primary growth would eradicate the disease.

Our failure in the treatment of cancer not only of the mouth but elsewhere in the body rests not upon our inability to destroy the primary lesion but upon our inadequate control of the metastasis.

In the neck we have what Dr. George W. Crile in 1906 called a "collar of lymphatics," which forms a barrier to the passage of lymphatic metastases. This barrier is superficially located and readily accessible to x-rays and to the surgical scalpel and the early malignant invasion is sensitive to both.

Dr. Allan Graham, a surgical pathologist of some note, once said that, if we would treat the earliest cancer in as radical a manner as we would treat the late case, our end results would assume a different character.

Assuming then that statistically the two methods of treatment are equal, I would like to make a plea for the thorough eradication of the cervical nodes in all cases where radium is applied to the primary growth, and a block dissection of this region where surgery is primarily employed.

Dr. Taylor has pointed out that the age and general condition of the patient must be given consideration, in which case the two methods may be combined with commendable results.

L. Henry Garland, M.D. (San Francisco, Calif.): Two present-day programs for the management of cervical lymph node metastases have been presented very ably by Drs. Taylor and Martin. Both authors agree on certain premises: (1) The primary lesion must have been controlled before the nodes are tackled. (2) If the primary lesion is uncontrollable, only palliation is indicated. Divergence is then acute, whether or not the nodes are palpable.

If *nodes are not palpable,* Dr. Taylor would do prophylactic neck dissection depending upon the probability of development of metastases and would base the extent of such dissection on the zones of lymphatic drainage involved.

This, of course, is a very tenuous situation. *First* the degree of probability of metastasis is quite variable in the individual clinical case, as well as with the different primaries. For two common primary sites, the approximate over-all incidence of metastatic nodes (both those initially present and those developing after treatment) is as follows: lip cancer 15 per cent; tongue cancer 60 per cent. However, the prophylactic problem comes up only with the cases having no node involvement at the time of control of the primary. In our own experience the following has been the rate of known metastatic involvement *developing after* initial observation: lip 4 per cent, tongue 15 per cent.

Second: The point of termination of the dissection is based on physical convenience and not anatomical fact. If low cervical nodes are involved, should not the mediastinal group be removed? Where is the ending?

Therefore, if one followed a policy of routine prophylactic neck dissection it would probably be unnecessary in 95 per cent of lip and perhaps 75 per cent of tongue cases, and it might have success

in only a quarter of those actually with node lesions. Neck dissection is no minor undertaking: its complications are significant and its clinical cure rate low. We are not enthusiastic about prophylactic dissection.

Dr. Martin would do no prophylactic neck irradiation. With this we concur.

If *nodes are palpable*, Dr. Taylor divides the cases into "operable" and "inoperable" groups. For the former he does neck dissection. For the latter he does what? We would like to know his recommended program.

Dr. Martin apparently treats palpable nodes irrespective of operability or extent. Nine of 17 patients with microscopically verified node metastases were well for five or more years, a remarkable feat (52 per cent). Forty of 146 patients with clinically diagnosed metastatic nodes were well for a similar period (an absolute "cure" rate of 27 per cent).

We would like to ask Dr. Martin to give the incidence of late serious skin or vessel necrosis following his intensive seven-day radium *cum* roentgen treatment. We have a few cases of metastatic squamous-cell cancer in a superficial cervical node which were controlled by external roentgen irradiation alone (all from lip primaries). Does he regard these as fortuitous?

Does Dr. Taylor have any absolute survival rates in neck node dissection (proved node cases)? Are his figures comparable with the *surgical* results for neck dissection quoted by Martin (absolute "cure" rate of 15 per cent)? He is to be congratulated on the "relative cure rate" figures of 38–58 per cent which he has reported today.

Dr. Taylor (*closing*): Dr. Garland has asked me one or two questions and I realize that perhaps I didn't make myself very clear. We are not going to do prophylactic neck dissections on lip cases as they come to the clinic. It is too much surgery for the benefit of too few people. But we do dissection if we have a high-grade malignant process in the lip which, according to the tables I showed, is likely to metastasize in about 52 per cent of cases, or if it is of long duration or of an extent greater than one or two centimeters. The problem, as Dr. Garland says, is to know whether metastases are present. Whether or not you can feel them is not of such great importance. I think they are likely to be there in certain cases, as noted. So in that sense the dissection is not "prophylactic." You can operate at once or defer operation two or three months until metastases are obvious and perhaps fixed to the jaw, as in some of Dr. Martin's cases. At this point when they become inoperable, you may want to do what Dr. MacComb did, the commando operation.

It is true that the patient who has lymph node metastases may have them established when he first comes to the clinic. I think the figures Dr. Garland dug up from his clinic are instructive. I can't quote our figures but we have published them.

Dr. Garland asked also about the absolute cure rates on survivors. These also we have published, although I can't recall at the moment the figures for each individual location and site. I will say that we were impressed as we reviewed our material by how often failure to effect a cure was due to failure to control the primary growth.

It was also asked what we do with the inoperable cases. That is what we have Dr. Schulz for. He takes over and he has explained how he helps to effect arrest or control of the disease. We are all tremendously impressed by Dr. Martin's results with irradiation. I think, as a matter of fact, I could perhaps teach my residents how to do a neck dissection better than I could teach them how to use the Martin technic in irradiation of the neck, and if we are going to accomplish the greatest good for the greatest number, I think we must inculcate in our disciples those procedures in which we think we may have technical skill. I think if we could all be Charlie Martins there would be perhaps no more surgery for neck cancer.

Dr. Martin (*closing*): Dr. Taylor has been very kind in his discussion of our work and I deeply appreciate his courtesy. It is quite unusual to have radiologists criticize a radiological method, and have it looked upon with favor by the surgeons, but that seems to be my problem today.

I am sorry that Dr. Garland could not find the time to visit our clinic and see some of our lymph node cases at first hand, when he was in Dallas. The figures given are absolute, since they cover all patients who applied for treatment. They all received irradiation and, although some of them were far advanced, none were moribund at the time of admission. When low-intensity radium needles are used in the neck properly, the sequelae about which Dr. Garland is so concerned do not occur. We have observed broken-down areas in the skin in a few cases, usually following trauma, several years after our radical type of therapy, but these complications have been easily handled by surgical resection.

In our early days we produced necroses of the mandible of the type shown by one of the essayists, in quite a few cases. Apparently this complication resulted from the simultaneous treatment of a lesion in the mouth and metastatic nodes in the submental region, with obliteration of the blood supply to the bony structures. Since overlapping fields have been eliminated, serious bone damage is seldom seen.

I would like to discuss some of the other papers in this excellent symposium, but time does not permit. Please allow me to thank the surgeons again for their open-minded attitude.

Roentgen Demonstration of the Common Duct Entering a Duodenal Diverticulum[1]

HUGH S. COLLETT, M.D.,[2] WALLACE S. TIRMAN, M.D., and HAROLD D. CAYLOR, M.D.

Bluffton, Ind.

CASES IN WHICH the common bile duct empties into a duodenal diverticulum instead of the duodenum are apparently rare. The first report of such an occurrence was made by Baldwin (1) in 1911. In a review of the literature at that time he had discovered no similar instance. In a personal series of 15 diverticula in 14 duodenums, however, he found 4 specimens in which the common bile duct terminated in the diverticulum. It was not until 1931 that another case was reported, by Benninghoven and Michael (2). These cases were all discovered postmortem. The case reported below we believe to be the first in which entrance of the common duct into the diverticulum was shown roentgenographically.

CASE REPORT

Mrs. A. R., a 61-year-old white woman, had been well until 1936, when she began to have episodes of right upper quadrant pain, jaundice, and loss of weight. In August 1941, cholecystectomy and choledochostomy were performed. The gallbladder was acutely inflamed, and stones were found in both the gallbladder and the common duct. Following surgery the common duct was drained by T-tube for sixteen days.

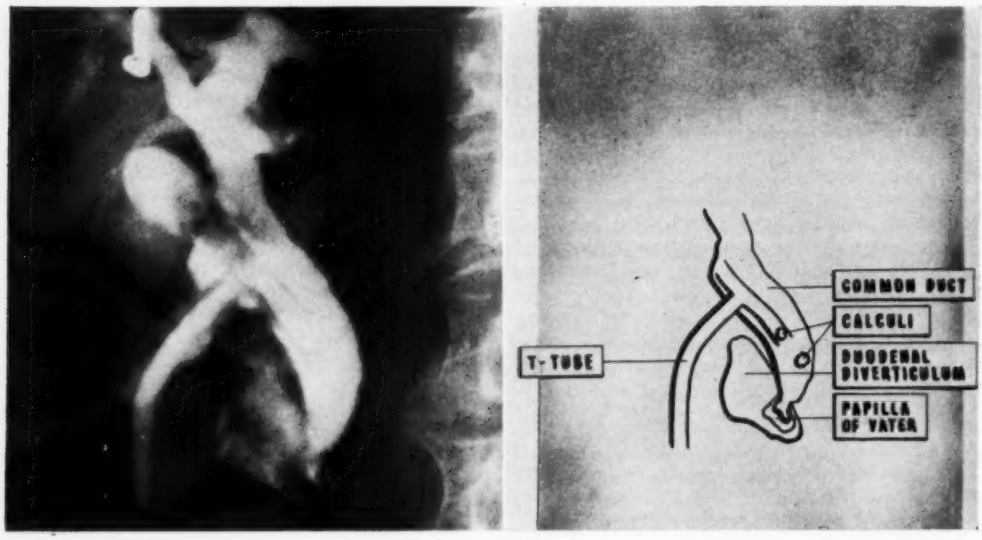


Fig. 1. Cholangiogram. A T-tube is present in a dilated common duct. The duct, filled with 35 per cent diodrast, is seen to empty into the diverticulum. The oval area of decreased density about the termination of the duct in the diverticulum represents, we believe, the papilla of Vater. The spot of increased density in its center is the termination of the common duct.

The subsequent history was uneventful until April 1944, when symptoms similar to those prior to operation recurred. At a second operation, in November 1944, the common duct was explored. The choledochus was found to be moderately dilated and to contain many stones and sandy material. It was noted at the time of surgery that the little finger could easily be inserted into what was believed to be the ampulla of Vater. The common duct was again drained by T-tube for twelve days, and the patient remained in good health until June

[1] From the Caylor-Nickel Clinic, Bluffton, Ind. Accepted for publication in August 1949.
[2] At present Resident in Surgery, St. Joseph's Hospital, San Francisco, Calif.

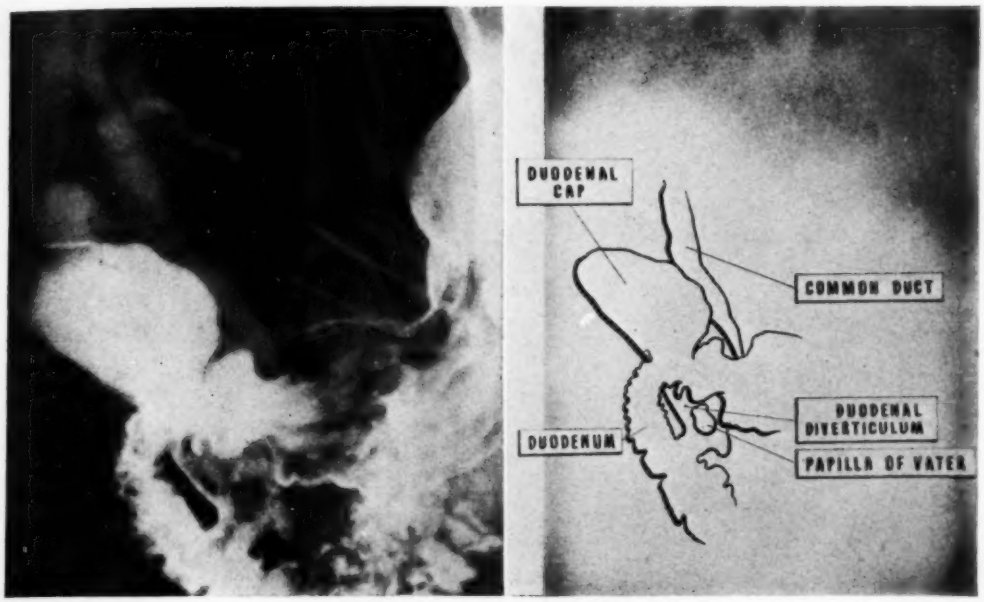


Fig. 2. Simultaneous cholangiogram and oral barium study. Barium is present in the duodenum and stomach. The distal portion of the common duct is hidden by the barium in the stomach. The papilla of Vater is shown in the diverticulum.

1948. At that time she once more presented evidence of choledocholithiasis: colicky right upper quadrant pain, chills, fever, jaundice, nausea, vomiting, and weight loss. A choledochostomy was performed, and many stones were removed from the common duct, which was dilated to 1 cm. in diameter. Cholangiography was attempted at the time of operation but was unsuccessful. Postoperative cholangiograms, with 35 per cent diodrast, however, showed several small stones in the common duct. Repeat cholangiograms revealed a large collection of dye adjacent to the distal portion of the common duct (Fig. 1). Oral administration of barium showed this to represent a diverticulum of the second portion of the duodenum, into which the common duct emptied (Fig. 2). The cholangiograms and barium studies revealed a defect in the opaque medium in the diverticulum about the termination of the common duct. It was felt that this represented the papilla of Vater (Fig. 3).

The patient was again operated upon in September 1948, because it was known that stones remained in the common duct. A few days prior to this operation, the T-tube which had been present since the previous surgery was inadvertently removed. When the incision was made, the stones were found in the sinus tract. The common duct was dilated. It was impossible to make a thorough search for the duodenal diverticulum because of the patient's poor general condition and adhesions and distortion of structures as a result of the three previous operations. On the fourth postoperative day the T-tube was accidentally removed, and no postoperative cholangiograms could be obtained. Convalescence was favorable, and the patient is now in good health.

In January 1949 a gastro-intestinal series was performed. During the fluoroscopic procedure an attempt was made to bring about regurgitation of barium into the common duct by pressure on the diverticulum. Barium in the stomach obscured the region of the diverticulum. A second study was made in March 1949. At that time a duodenal tube was introduced to the region of the diverticulum and 70 per cent diodrast was injected. The diverticulum was well demonstrated and the rounded defect which had previously been interpreted as the papilla of Vater was again noted. An unsuccessful attempt was made to fill the common duct with dye by exerting pressure on the diverticulum.

REVIEW OF LITERATURE

Before the reports of Baldwin (1), and of Case (3) some years later, duodenal diverticula were considered to be rare. They are now accepted as of common occurrence. Whitmore (7), summarizing the reports of many authors, found the incidence of diverticula in various portions of the duodenum to be: 5.6 per cent in the first part, 65.4 per cent in the second part, and 29 per cent in the third and fourth parts. The

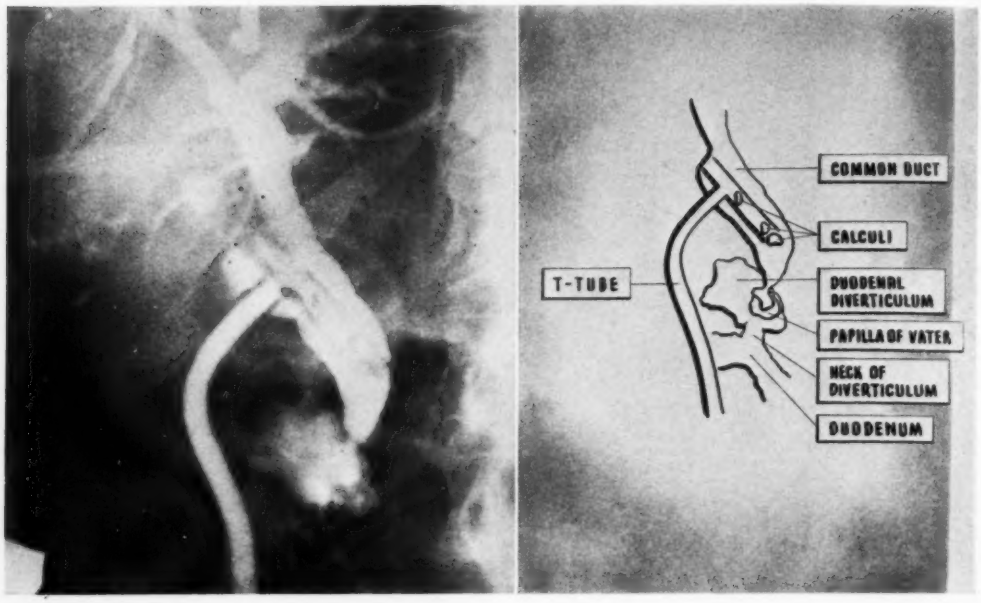


Fig. 3. Cholangiogram. The diverticulum is well shown in this illustration, with the mucosal folds of the duodenum extending into it. A T-tube is present in the common duct and the duct is filled with 35 per cent diodrast. The duct terminates in the diverticulum and the papilla is demonstrated about its termination. Several calculi are present in the T-tube and common duct.

majority occur near the ampulla of Vater.

To our knowledge only five cases have been reported in which the common duct entered a duodenal diverticulum, a low figure when it is considered that duodenal diverticula occur frequently and that the majority are near the ampulla of Vater. Baldwin, as previously stated, found four instances in which the common bile duct entered into a duodenal diverticulum, and Benninghoven and Michael contributed a fifth case. Baldwin's four cases were described as follows:

"*Specimen 3:* In this subject a diverticulum of unusual size projected into the head of the pancreas. . . . Within the sac a prominent fold of mucosa 0.9 cm. broad and 2.2 cm. long passed cephalo-caudally across the dorsal wall. The bile duct, traversing this fold at some distance from its free edge, terminated at the major duodenal papilla 1.0 cm. within the sac at the junction of its dorsal and caudal walls. The main pancreatic duct passed dorsal to the diverticulum to open at the major papilla with the bile duct."

"*Specimen 5:* The bile duct in company with the main pancreatic duct traversed the dorsal wall of the sac, both opening at the major papilla which was situated 0.7 cm. within the orifice upon the dorsal wall of the diverticulum. A prominent fold of mucosa bearing this papilla upon its crest ran caudally across the dorsal wall. . . ."

"*Specimen 6:* At the common orifice of the bile and main pancreatic ducts a globular diverticulum 1.5 cm. in depth and 1.2 cm. in the other dimensions, lying dorsal to the head of the pancreas, opened into the duodenum. . . . The ducts lay along the caudal wall of the sac with their orifice at its caudal lip."

"*Specimen 7:* A small, shallow, funnel-shaped diverticulum. . . of the duodenum presenting in its depth the conjoined orifice of the bile and main pancreatic ducts. . . ."

Baldwin reviewed all of the reported cases of duodenal diverticula. There had been described up to the time of his report, including his own cases, 83 diverticula in 63 duodenums. His series of 14 specimens included all of the cases in which the major papilla of the duodenum was found inside a duodenal diverticulum.

Benninghoven and Michael, describing their case, wrote:

"The common duct is covered by fairly dense adhesions and empties through the ampulla of Vater into a large diverticulum about 2.5 cm. in diameter. The latter opens into the duodenum proper by a

wide neck. It contains all the layers of the intestine."

DISCUSSION

In the case reported here, the termination of the common duct in a duodenal diverticulum was shown roentgenologically. The presence of a T-tube in the common duct gave an opportunity for demonstrating this apparently infrequent finding.

When the postoperative cholangiograms revealed a large collection of dye adjacent to the distal portion of the common duct, many additional films were taken in an attempt to determine its nature. A simultaneous gastro-intestinal series and cholangiogram showed the collection to represent a duodenal diverticulum of the second portion of the duodenum. In none of the films was any dye seen entering the duodenum except *via* the diverticulum. This was also noted on fluoroscopy during cholangiography. A non-opaque area was constantly found in the center of the diverticulum, which was similar to the radiological appearance of the papilla of Vater as described by Feldman (4). Mucosal folds of the duodenum were seen entering the diverticulum. Although pathological proof is lacking, we believe the roentgen findings are sufficiently definite to permit the conclusion that the common duct enters the diverticulum rather than the duodenum proper.

Other conditions which might present a somewhat similar picture may be excluded by virtue of the above findings. Pendergrass (5) showed that the ampulla of Vater occasionally filled with barium during a gastro-intestinal x-ray series. The mucosal folds of the duodenum entering the diverticulum and the papilla of Vater seen in the diverticulum exclude this possibility.

A choledochus cyst, because of its location, might conceivably be difficult to differentiate from a duodenal diverticulum into which the common duct entered. Walton (6) stated that the common duct between the cyst and the duodenum was usually constricted. The neck of this diverticulum was wide enough to allow free flow of barium into the diverticulum.

There is no accepted explanation for the entrance of the common duct into a duodenal diverticulum. Baldwin believed that it was due to "either persistence of the original diverticulum from which the liver and ventral anlage or the pancreas developed or possibly due to the traction effects of the ducts on the duodenal wall." Benninghoven, in explaining his case, felt that adhesions about the gallbladder, common bile duct, and duodenum could have formed the diverticulum by traction. In the case reported here it is possible that previous gallbladder disease was responsible for the production of the diverticulum at the site of the papilla. It is our belief that these diverticula have an etiology similar to that of other duodenal diverticula. Many theories have been advanced regarding their cause, but none has been generally accepted. Frequently there is no evidence either in the diverticula or the surrounding tissue to explain their formation. This fact, together with their increasing incidence after the fifth decade and their absence in infants and children, suggests the possibility that the normal aging process may be the factor responsible for their production.

CONCLUSIONS

1. A case of termination of the common duct in a duodenal diverticulum, demonstrated roentgenologically, is reported.
2. A review of the literature revealed only 5 cases in which the common duct entered a duodenal diverticulum but in none of these was roentgen evidence of the condition obtained.
3. In the differential diagnosis of this condition, a common duct cyst and a dilated ampulla of Vater must be considered.
4. The possibility that duodenal diverticula may be due to a normal aging process is suggested.

NOTE: We wish to thank Mr. Harry Lindstrand for the descriptive drawings and Dr. Fred Carter for the photographic reproductions.

REFERENCES

1. BALDWIN, W. M.: Duodenal Diverticula in Man. Anat. Rec. **5:** 121, 1911.
2. BENNINGHOVEN, C., AND MICHAEL, P.: Common Bile Duct Emptying into Duodenal Diverticulum: Case Report. Radiology **17:** 579–581, 1931.
3. CASE, J. T.: Diverticulum of the Small Intestine, Other Than Meckel's Diverticulum. J. A. M. A. **75:** 1463, 1920.
4. FELDMAN, M.: Terminal Common Bile Duct and Duodenal Papilla: A Roentgenological Consideration. Surg., Gynec. & Obst. **73:** 838–844, 1941.
5. PENDERGRASS, R. C.: Roentgen Diagnosis of Duodenal Diverticula. Radiology **17:** 1216–1229, 1931.
6. WALTON, J.: Congenital Diverticulum of the Common Bile-Duct. Brit. J. Surg. **27:** 295–315, 1939.
7. WHITMORE, W. H.: Duodenal Diverticula with Ulceration. Am. J. Roentgenol. **59:** 343–350, 1948.

SUMARIO

Observación Roentgenológica del Colédoco Penetrando en un Divertículo Duodenal

Comunícase un caso con datos roentgenológicos de la terminación del colédoco en un divertículo duodenal. El repaso de la literatura reveló 5 casos anteriores en que el colédoco penetraba en un divertículo duodenal, pero en ninguno descubrió el estado roentgenológicamente.

En el diagnóstico diferencial del estado aquí descrito, hay que considerar quiste del colédoco y dilatación de la papila de Santorini.

Es possible que los divertículos duodenales procedan de un proceso normal del envejecimiento.

Electrokymographic Observations in Constrictive Pericarditis[1]

FREDERICK G. GILLICK, M.D.,[2] and WILLIAM F. REYNOLDS, M.D.[3]

THE ADVANCES which have been made in cardiac surgery in the past two decades emphasize the importance of early recognition of restriction of diastolic filling of the heart due to pericardial disease. Critical examination of the criteria given by a number of writers (1, 2, 9, 10, 11, 12, 14) for the diagnosis of constrictive pericarditis indicates that indirect evidence is often the only kind available. In the hope of obtaining additional information of diagnostic significance, it has seemed worth while to conduct electrokymographic studies of patients with this disease.

The clinical effects of constrictive pericarditis have been adequately reviewed in the literature by Beck (1, 2) and others (8, 13) and need not be repeated here. It is, however, of importance to note that signs of venous stasis and decreased stroke volume, while occurring in constrictive pericarditis, may also be observed in congestive failure, caval obstruction, and other conditions (14). The remaining component of the triad, namely, a "small quiet heart," proved an invalid criterion in a study by Stewart, Carty, and Seal (12), who reported slight to marked enlargement in 13 out of 16 cases of constrictive pericarditis. Harrison and White (8) found slightly to moderately enlarged hearts in 19 of 37 patients with constrictive pericarditis, while 18 had hearts of normal size. It follows, therefore, that in the presence of venous stasis, reduced cardiac output, and a normal or enlarged cardiac silhouette, the diagnosis of constrictive pericarditis must be considered.

The clinical consequences of chronic constrictive pericarditis are primarily the result of mechanical limitation of diastolic filling of the ventricle. There are, in general, two types of roentgen evidence which help in the establishment of this diagnosis. These are: (1) signs indicative of disease involving the pericardium and adjacent structures, capable of producing the mechanical situation postulated; (2) abnormality of the movements of the cardiac and great vessel borders consistent with this mechanical situation.

Chronic disease of the pericardium is suggested by three roentgenologic observations. (1) Shell-like calcification along the cardiac borders may be seen by fluoroscopy or on the x-ray film. This calcification is not necessarily evidence of rigidity or reduction in volume of the pericardial sac. It is more often absent than present, having been reported in only 25 to 44 per cent of various series (6, 8, 11, 12). (2) Loss of distinctness, in the cardiac silhouette, of the points of junction or overlapping of the borders of the heart and great vessels is significant, since it suggests thickening of the pericardium. The shape of the heart shadow is not otherwise helpful. (3) Fluoroscopic demonstration of fixation of the mediastinum helps, since the pericardium is likely to be involved.

Cardiac movements and pulsations of the great vessels have been investigated with the fluoroscope and with the roentgenkymograph, and three abnormalities have been described: (1) The amplitude of the movements over large segments of the ventricular wall is reduced. This is not critical evidence since it also occurs in cardiac decompensation with great dilatation and with pericardial effusion. Furthermore, the lateral excursions of the ventricular walls may be exaggerated in some areas in which the overlying pericardium

[1] This work was done by a Cooperative Cardiovascular Project supported jointly by the United States Public Health Service and the University of California. Accepted for publication in August 1949.

[2] Senior Surgeon, United States Public Health Service, Washington, D. C., formerly Research Associate in Medicine at the University of California Medical School, San Francisco, Calif.

[3] Assistant Professor of Radiology, University of California Medical School, San Francisco, Calif.

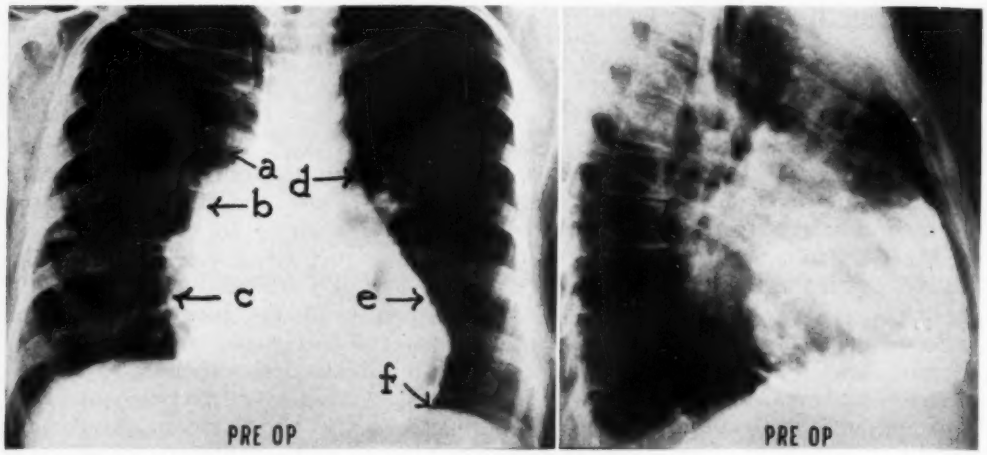


Fig. 1. Case 1. Roentgenograms showing calcification at the periphery of the heart border and extending up along the root of the ascending aorta. Arrows indicate the points at which the electrokymograms shown in Fig. 2 were obtained.

is more flexible than elsewhere. (2) Qualitative, as distinguished from quantitative, changes in the contour of the kymographic wave also have been described as characteristic. Stumpf and his co-workers (13), Berner (3) and Stewart and his associates (12) have all described a plateau-like appearance in the diastolic phase. Stumpf also speaks of a "pointed" wave pattern, and Berner of the occurrence of "double waves." (3) Marked reduction of the pulsations of the aorta, resulting from the diminished output of the ventricle, has been described (11, 12).

Because of the similarities of the electrokymograph and the roentgenkymograph, and particularly because the electrokymograph is capable of magnifying the records of the motions of the heart, four patients with constrictive pericarditis were examined by this method. Operations have been performed since on three of these patients and the diagnosis has been confirmed. The fourth patient is a poor surgical risk because of his age and general arteriosclerosis. For this reason no operation has been performed, but the diagnosis appears to be well established. In addition, a patient with a rather broad pleuropericardial adhesion has been examined.

Electrokymographic studies were made on the following areas of the cardiac silhouette: Left ventricle, in five or more positions; lower portion of the right border, in two or more positions; ascending aorta; aortic knob; pulmonary artery.

CASE REPORTS

CASE 1: V. O., a white female aged 49, entered the University of California Hospital on Jan. 5, 1948. Twenty years before entry into the hospital she had been told that her heart was enlarged. She had been aware of cyanosis of the lips after exertion for two years prior to hospitalization. Dyspnea on exertion had been present one and one-half years. For four months she had had a chronic, non-productive cough and ankle edema. During the previous six weeks she had been confined to bed because of dyspnea and edema. Six months prior to entry a chest film had been reported as showing "a case over the heart."

Physical examination showed distention of the veins of the neck, questionable enlargement of the heart toward the left, an irregular cardiac rhythm, and a rough friction rub over the left second interspace. The edge of the liver was palpable 4 cm. below the costal margin. No edema or cyanosis was present. The blood pressure was 125/95. The venous pressure was 26 cm. of water. The vital capacity was 1,400 c.c.

The electrocardiogram was reported by Dr. Maurice Sokolow as being abnormal, but not characteristic of a particular disease process. Auricular fibrillation was demonstrated.

Roentgenologic examination (Fig. 1) on Jan. 6, 1948, showed that the heart was enlarged. About

the periphery of its lower two-thirds and also along the root of the aorta calcification was demonstrated. By fluoroscopy it was seen that the heart movements were regular in their rhythm. A brief pause was observed between the outward and inward movements of the cardiac borders, suggesting that the calcified pericardial sac was limiting the ventricles from expanding to their fullest extent. Movements of the borders of the upper third of the heart appeared normal.

CASE 2: R. P. A., a Negro male aged 16, entered the University of California Hospital on Nov. 13, 1947. Three years prior to admission to the hospital he had been told that he had a heart murmur. Shortly thereafter he noticed dyspnea on exertion and increasing fatigue. A diagnosis of rheumatic myocarditis had been made and he had been kept in bed for eight months. For two years his heart and liver had been considered slightly enlarged. During the previous year ascites and distention

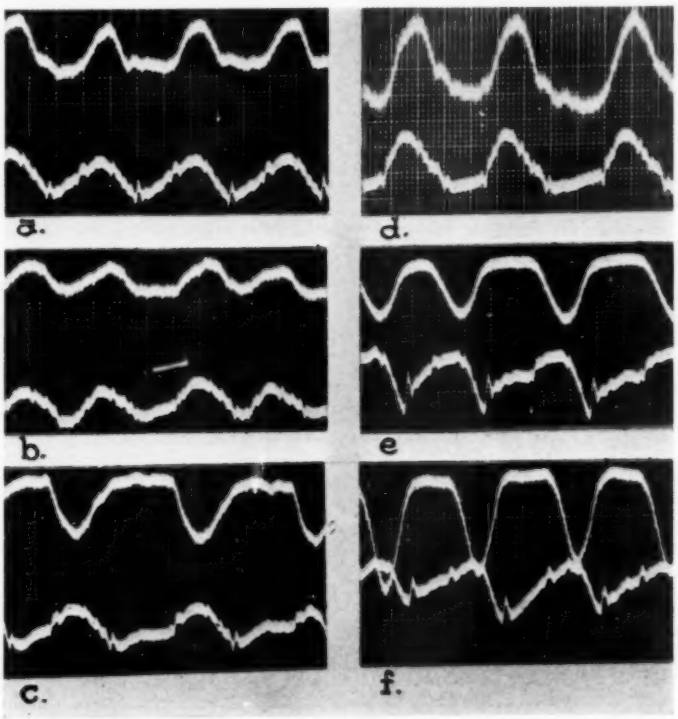


Fig. 2. Electrokymograms on Case 1 at selected points of the cardiac silhouette as indicated in Fig. 1. Upper curve is the electrokymogram; lower curve is the pulse wave of the carotid artery. *a*. Ascending aorta. *b*. Spicule of calcium at the root of the aorta. *c*. Mid portion of right border showing plateau-like curve. *d*. Pulmonary artery. *e* and *f*. Middle and lower portions of the left border, showing plateau-like curve. Note wave on carotid pulse coincident with onset of diastolic plateau of the electrokymogram.

A pericardectomy was done on Jan. 30, 1948, by Dr. H. Brodie Stephens. He described approximately 85 per cent of the pericardium as being thickened (0.5 to 1.0 cm.), with marked calcification of all of its layers. The pericardium was adherent in many places to the epicardium, but the latter for the most part showed no signs of chronic inflammation. Between two-thirds and three-fourths of the pericardium was removed. Dr. Elizabeth Lowenhaupt, the pathologist who examined the tissue found evidence only of pericardial fibrosis and calcification.

of the veins of the arms and neck had been apparent, and dyspnea had increased. An x-ray examination of the chest, on Oct. 17, 1947, showed calcification of the pericardium near the apex of the heart.

Physical examination on admission showed distention of the veins of the upper thorax, arms, and abdomen. Ascites was present, and the heart was enlarged both to right and left. The heart sounds were of diminished intensity and there was a soft systolic murmur at the apex. The edge of the liver was felt five fingerbreadths below the costal margin. The blood pressure was 110/68. Venous pressure

ranged from 30 to 38.5 cm. of water. The electrocardiogram was reported as abnormal but of no characteristic pattern.

A pericardectomy was performed by Dr. H. Brodie Stephens on Nov. 14, 1947. A firm band of scar tissue was found arranged in the form of a tube completely encircling the left ventricle approximately 6 cm. from its apex. There was a larger area of scar tissue opposite the junction of the anterior and diaphragmatic surfaces of the heart. The epicardium elsewhere on the anterior surfaces of the right and left ventricles was rather thin, semitranslucent, and did not appear to be constricting the ventricles. The diagnosis of the pathologist, Dr. J. F. Rinehart, after examination of the tissue removed, was chronic inflammation and fibrosis. The tuberculous nature of the inflammation was demonstrated by smears of the pericardial fluid and by inoculation of this fluid into guinea-pigs.

CASE 3: M. B. M., a white male aged 24, was admitted to the University of California Clinic on Jan. 14, 1937. At the age of twelve he had had an episode lasting four or five days called "influenza fever," with a cough productive of thick sputum and sharp pain under the sternum and over the left anterior thorax and epigastrium. He had been kept in bed about two weeks, then gradually resumed full activity and had felt well. Similar episodes had occurred at the age of sixteen and again at seventeen, each of about two or three weeks duration.

At the age of fifteen the patient had been forced by exertional dyspnea to stop participating in sports. By January 1937, he had become markedly dyspneic

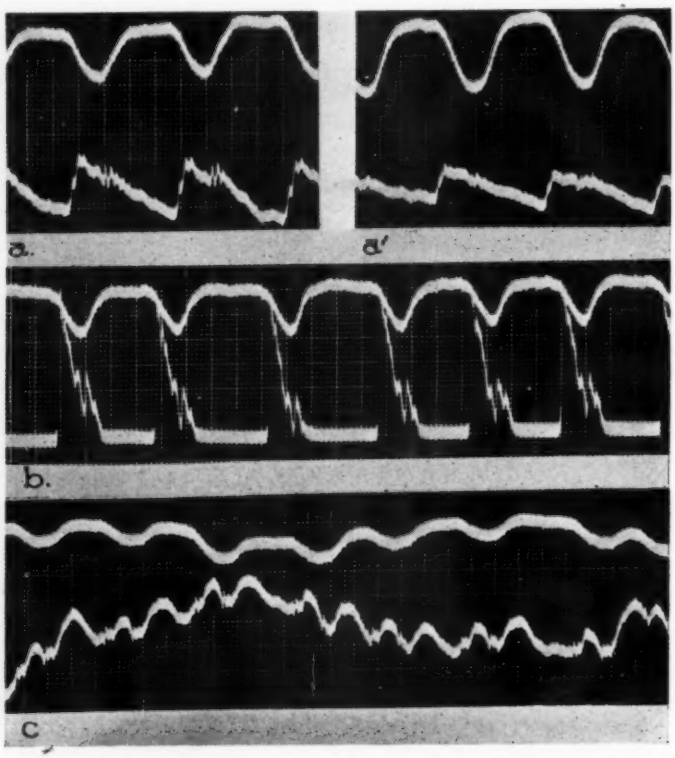


Fig. 3. Electrokymograms from Cases 2, 3, and 4. All of these were obtained with the patient in the anteroposterior position. The electrokymogram is above and the carotid pulse wave below, in each tracing. Note the small upward wave in *a* and *a'* and the larger upward wave in *c*, in the tracing of the carotid pulse wave at approximately the onset of the diastolic plateau of the electrokymogram. All of these tracings demonstrate the plateau-like ventricular curve.

a. Case 2, from the mid portion of the right cardiac border. *a'*. Case 2, from the mid portion of the left border.

b. Case 3, from the mid portion of the left cardiac border.

c. Case 4, from the mid portion of the left cardiac border.

when walking on level ground. His activity was almost completely curtailed; he spent most of the day in bed or in a chair.

On physical examination, Jan. 14, 1937, there was seen to be moderate cyanosis of the lips, hands, feet, and mucous membranes. The neck veins were markedly engorged. No clubbing of the fingers or ankle edema was present. Slight inward retraction of the lower third of the sternum occurred with inspiration. A dull percussion note, impaired breath sounds, and increased tactile fremitus were found over both lung bases posteriorly. The area of cardiac dullness on percussion was increased markedly to right and left. The liver edge was palpable four fingerbreadths below the right costal margin. The spleen was palpable but not greatly enlarged. The pulse was irregular, with a deficit at the radial artery of four to six beats per minute. The blood pressure was 100/70.

Roentgenologic examination showed definite cardiac enlargement involving all chambers. Calcification was demonstrated along the anterior wall of the right ventricle. Thickening of the pleural surfaces between the right upper and middle lobes, obliteration of the right costophrenic angle, and a small pleural effusion on the left side were observed. With the fluoroscope, the cardiac pulsations were seen to be small in amplitude.

The patient was hospitalized for study. Venous pressure in the right arm was found to be 22 cm. of water, and in the left arm 23 cm. The circulation time, from arm to tongue, determined by the neocalcium gluconate method, was twenty-four seconds. Vital capacity was 1,800 c.c. An electrocardiogram was reported by Dr. D. W. Bennett to show right axis deviation, auricular fibrillation, and evidence of myocardial damage.

On Feb. 22, 1937, a subtotal resection of the parietal pericardium was done by Dr. Claude Beck. The parietal pericardium was found to be 5 mm. thick, a definite casing envelope limiting cardiac expansion. Increased palpatory resistance was present in the area in which calcification was seen in the x-ray films, chiefly over the right auricle and diaphragmatic surface of the right ventricle. The parietal pericardium was adherent to the right auricle between the cavae and presented a thick fibrous band which partially compressed the superior and inferior venae cavae. The visceral pericardium was apparently thickened, with a few filmy fibrous adhesions between the pericardial surfaces.

The parietal pericardium was resected in three segments from the surface overlying the two ventricles and from the region of the right auricle. The band compressing the cavae was divided. The pericardium was adherent posteriorly, and an area 6 or 8 cm. square could not be resected. Pulsations were increased in amplitude as soon as the pericardium was incised, and the circulation was definitely improved.

Pathologic examination by Dr. E. I. Bartlett revealed chronic adhesive pericarditis.

The venous pressure decreased to 9.5 cm. of water in the right arm postoperatively. After discharge from the hospital, the patient was able to do light work. Dyspnea on exertion returned by 1943 with easy fatigability. Venous pressure was recorded as 18 cm. on July 7, 1945; 23 cm. on Dec. 13, 1945; 9 cm. on June 15, 1946. Edema of the extremities was present at times. The heart size increased over that seen in the postoperative films. There developed a constant systolic murmur at the apex, transmitted to the axilla, and persistent auricular fibrillation.

The patient was admitted to the hospital for the last time on March 3, 1948, after a severe episode of dyspnea and edema. The physical and laboratory findings were similar to those at the time of his first admission. No cyanosis was present. Pulsus paradoxicus and auricular fibrillation were observed. Venous pressure was 32 cm. but decreased to 17 cm. on March 11, 1948, after administration of digitalis, mercupurin, and aminophyllin. By March 28 it had again increased to 23.7 cm.

A second pericardectomy was performed March 29, 1948, by Dr. H. Brodie Stephens. He found the pericardium over the anterior surface of the heart fibrotic and thickened. Thick calcified pericardium was found overlying the apex, the right lateral aspect of the heart, and its entire posterior surface. A constricting ring was found about the inferior vena cava. Ventricular fibrillation began during the procedure and the patient died despite determined efforts on the part of the surgeon, including maintenance of peripheral circulation for two hours or more by cardiac massage. There was no autopsy.

CASE 4: C. D. B., a white male aged 76, entered the University of California Out-Patient Department in March 1939, because of severe pain in his left lower chest. A diagnosis of pleuritis and pericarditis was made. Tuberculosis was suspected but never proved. Dyspnea on exertion and edema of the ankles developed several months later. The patient has been under observation at the clinic from 1939 until his most recent visit, Nov. 19, 1948. His clinical course has fluctuated, marked by episodes of severe congestive failure and relative improvement with digitalization, diuretics, and bed rest.

During the nine-year period physical examination has always showed cardiac and liver enlargement. Cyanosis, venous distention, and peripheral edema have varied in degree. Auricular fibrillation has been present most of the time that the patient has been under observation. The blood pressure has ranged from 150/96 in 1943 to 108/78 on Aug. 6, 1948. Venous pressure has varied from 9.5 to 24 cm. of water.

Electrocardiograms obtained at intervals have been described by Dr. Maurice Sokolow as abnormal,

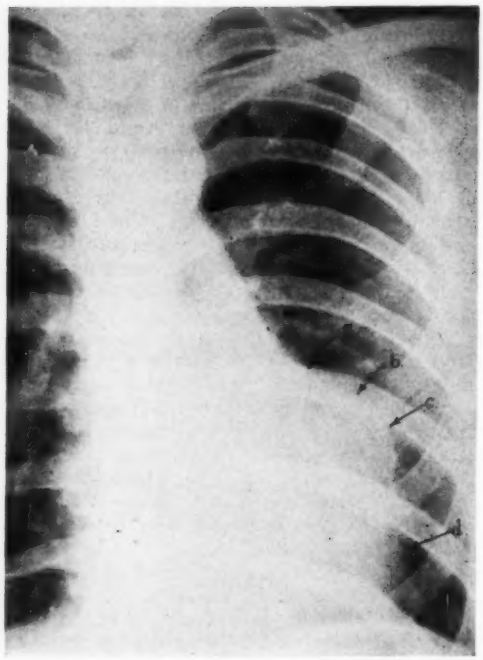


Fig. 4. Case 5. The upper portion of the left cardiac border is distorted by adhesions between the pericardium and the pleura along the anterolateral chest wall. Arrows indicate points at which the electrokymograms shown in Fig. 5 were obtained.

most of them showing auricular fibrillation. One episode of auricular flutter with arteriovenous block has been recorded.

A roentgenologic examination in March 1940 showed that the heart was not enlarged. Extensive calcification of the pericardium was seen involving the ventricular walls anteriorly, the lateral wall of the left ventricle, and the entire diaphragmatic surface of both ventricles. The contractions of the heart were diminished in amplitude, but still clearly discernible. There was marked thickening of the left pleura, extending upward toward the axilla and posteriorly. The left leaf of the diaphragm could not be seen by fluoroscopy but the right leaf moved. On films obtained on Nov. 16, 1943, there appeared to be more calcification along the anterolateral wall of the right ventricle than before. When the patient was examined on June 5, 1948, it was seen that no demonstrable change had occurred since 1943.

CASE 5: W. D. L., a Chinese male aged 20, entered the University of California Out-Patient Department on Feb. 17, 1948. In 1934 he had had pneumonia, which was considered at that time to be tuberculous, and was hospitalized for a period of eighteen months. A left hydrothorax developed during this period and was not completely resorbed until 1938. Shortly before admission to the University of California Clinic, pleuropericardial adhesions along the left cardiac border were seen by fluoroscopy, and the patient was sent to the clinic for study. Except for tiring easily, he had no symptoms.

Physical examination showed that the left half of the chest was smaller than the right. Heart borders apparently did not shift with change in position. A systolic murmur was heard at the fourth intercostal space just to the left of the sternum. The examination of the abdomen was negative. The blood pressure was 110/64. Venous pressure ranged from 9 cm. to 16 cm. of water. The electrocardiogram was reported by Dr. Maurice Sokolow as being within normal limits, with marked clockwise rotation of the heart.

Roentgenologic examination on March 18, 1948 (Fig. 4) showed that the heart was not enlarged. A rounded outward extension of the left cardiac border in its mid portion was seen. Pulsations were prominent in this region, less prominent than usual above and below this area. No evidence was seen of calcification in the pericardium. On reexamination, Aug. 2, 1948, no additional observations were made. It was concluded that there was evidence of pleuropericardial adhesions along the left border, but not sufficient evidence for a diagnosis of constrictive pericarditis.

ELECTROKYMOGRAPHIC RESULTS

In the first four cases described, a distinctive electrokymographic curve was obtained from the ventricular borders. A description of the appearance of the normal electrokymogram has appeared elsewhere (4, 5, 7) and therefore is omitted here. It is important to recall, however, that in tracings from the normal ventricle the line representing the movement of the ventricle border rises steeply in early diastole and more gradually toward the end of the filling of the ventricle (Fig. 5*d*). In the ventricular electrokymograms (Figs. 2 and 3) of the patients reported, the initial steep rise occurred during early diastole. The line then moved in a direction almost parallel to the base line, continuing in this direction until the descent corresponding to systolic contraction occurred. The resulting plateau-like appearance would seem to show that the ventricular wall expanded to the limit permitted by its inelastic shell, and then remained in this position until the ventricle contracted again.

In the case of the patient with the pleuro-

pericardial adhesion (Case 5), tracings of the same form were obtained from the portion of the border of the left ventricle in the immediate neighborhood of the adhesion, but not at other points (Figs. 4 and 5).

It is of interest to note that an upward wave occurs on the carotid pulse tracing at approximately the onset of the diastolic plateau of the electrokymogram in three patients (Case 1, Fig. 2; Case 2, Fig. 3A and A[1]; Case 4, Fig 3C) presenting the clinical picture of chronic constrictive pericarditis. The significance of this observation, while not discussed in this paper, is under study.

DISCUSSION

It must be pointed out that a plateau-like curve during the greater part of diastole is not pathognomonic of constrictive pericarditis, but can occur in other conditions. A marked bradycardia, such as is seen with complete auriculoventricular block, produces an electrokymogram with a plateau-like wave during a significantly large part of diastole. This occurs because there is a normal limit to diastolic filling, perhaps set by myocardial tonus, perhaps by the normal pericardium. When this limit is reached, the lateral movement of the ventricular border ceases. In this situation there are no signs of venous stasis or impaired cardiac output, unless frank congestive failure is present. Extrapericardial disease conceivably could limit cardiac movement and thus produce the plateau wave in diastole. However, this has not been observed to date. We would expect, under such circumstances, to see evidence of such a condition in the x-ray film. Occasionally, a diastolic plateau wave has been observed over the right border of the heart; it is felt that such a wave reflects an infrequent result of the combined movements of the right auricle and right ventricle. As experience increases in the field of electrokymography, other conditions may be found in which this type of ventricular curve occurs. However, examination of patients with acute pericarditis and pericardial effusion thus far has not shown it.

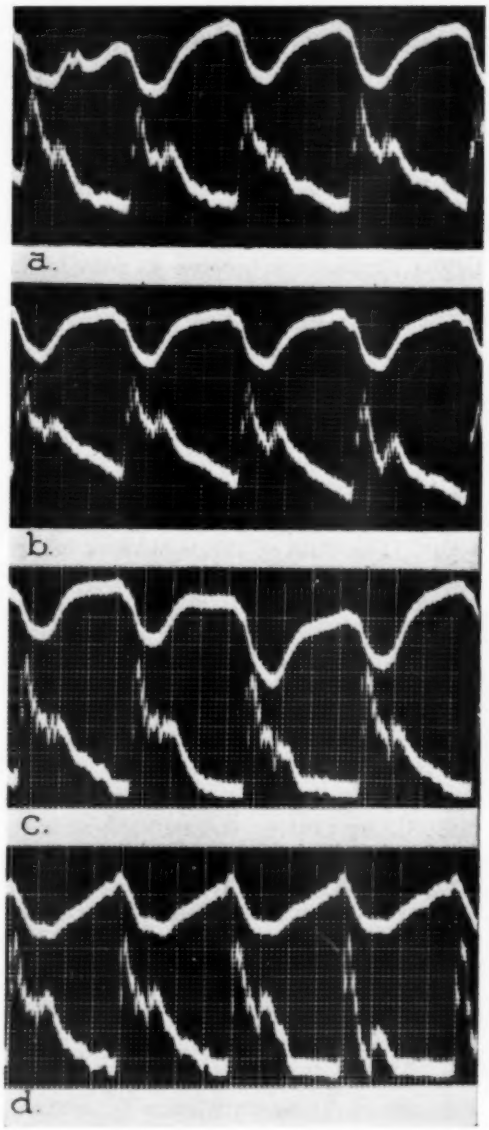


Fig. 5. Electrokymograms of Case 5 obtained at the points corresponding to the arrows along the border of the left ventricle as shown in Fig. 4. Tracings *a* and *d* illustrate the usual appearance of the ventricular electrokymogram. The plateau form is seen in *b* and *c*.

From the above observations, it is our opinion that an electrokymogram of the left ventricle which shows a plateau-like curve, beginning shortly after the onset of

diastole and continuing until its completion, suggests pericardial constriction under the following conditions: (1) that the cardiac rate is normal; (2) that roentgenographic examination of the chest does not demonstrate extrapericardial obstruction of cardiac motion; (3) that consistent clinical signs and symptoms are present. It is felt that this phenomenon is of particular significance because it graphically demonstrates the physiological abnormality that determines the clinical picture associated with chronic constrictive pericarditis.

The electrokymograph is particularly useful in the study of this problem because it can produce a relatively large tracing by electronic amplification even when very small ventricular excursions occur. The value of this is obvious. Since tracings can be obtained easily in the fluoroscopic room, it is hoped that use of the electrokymograph on all patients with venous stasis may detect pericardial constriction in cases in which it has not been suspected.

SUMMARY

1. A plateau-like appearance of the diastolic portion of the ventricular electrokymographic tracing is described as characteristic of constrictive pericarditis, under the proper conditions. Other causes of this appearance are discussed.

2. Four cases of constrictive pericarditis in which electrokymographic tracings of this type were obtained are reported. In another patient, with a pleuropericardial adhesion, electrokymograms obtained near the adhesion showed the same appearance.

3. Recognition of pericardial constriction in patients in whom it is not suspected is suggested as one of the benefits of using electrokymography routinely in addition to fluoroscopy of patients with cardiac disease.

National Heart Institute
National Institutes of Health
Bethesda 14, Md.

BIBLIOGRAPHY

1. BECK, C. S.: Acute and Chronic Compression of the Heart. Am. Heart J. **14:** 515–525, 1937.

2. BECK, C. S.: Compression of the Heart. Radiology **37:** 47–52, 1941.

3. BERNER, F.: Die kymographische Untersuchung der Pericarditis calculosa. Arch. f. klin. Chir. **194:** 458–476, 1939.

4. BOONE, B. R., ELLINGER, G. F., and GILLICK, F. G.: Electrokymography of the Heart and Great Vessels: Principles and Application. Ann. Int. Med. **31:** 1030–1056, 1949.

5. BOONE, B. R., CHAMBERLAIN, W. E., GILLICK, F. G., and HENNY, G. C.: Interpreting the Electrokymogram of Heart and Great Vessel Motion. Am. Heart J. **34:** 560–568, 1947.

6. FREEDMAN, E.: Roentgenological Diagnosis of Cardiac Compression due to Pericardial Scar (Adhesive Pericarditis). Am. J. Roentgenol. **37:** 739–752, 1937.

7. GILLICK, F. G., AND REYNOLDS, W. F.: Clinical Application of Electrokymography. California Med. **70:** 407–412, 1949.

8. HARRISON, M. B., AND WHITE, P. D.: Chronic Constrictive Pericarditis; A Follow-up Study of 37 Cases. Ann. Int. Med. **17:** 790–806, 1942.

9. HEUER, G. J., AND STEWART, H. J.: Surgical Treatment of Constrictive Pericarditis. S. Clin. North America **26:** 477–488, 1946.

10. OPPENHEIMER, B. S., HITZIG, W. M., AND NEUHOF, H.: Chronic Constrictive Pericarditis: Medical and Surgical Aspects. J. Mt. Sinai Hosp. **7:** 270–289, 1941.

11. RIGLER, L. G., WANGENSTEEN, O. H., AND FRIEDELL, H. L.: Roentgenkymography in Constrictive Pericarditis. Am. J. Roentgenol. **46:** 765–777, 1941.

12. STEWART, H. J., CARTY, J. R., AND SEAL, J. R.: Contributions of Roentgenology to the Diagnosis of Chronic Constrictive Pericarditis. Am. J. Roentgenol. **49:** 349–365, 1943.

13. STUMPF, P., WEBER, H. H., AND WELTZ, G. A.: Röntgenkymographische Bewegungslehre innerer Organe. Leipzig, Georg Thieme, 1936.

14. WHITE, P. D.: Chronic Constrictive Pericarditis (Pick's Disease), Treated by Pericardial Resection. Lancet **2:** 539 and 597, 1935.

SUMARIO

Observaciones Electroquimográficas en la Pericarditis Constrictiva

El aspecto en meseta de la porción diastólica del electroquimograma del ventrículo izquierdo resulta indicativo de pericarditis constrictiva en las siguientes circunstancias: (a) si la velocidad cardíaca es normal; (b) si el examen roentgenológico del tórax no revela obstrucción extrapericardíaca del movimiento cardíaco; (c) si hay signos clínicos y síntomas compatibles con el estado.

En ciertos otros estados puede obtenerse un trazado electroquimográfico semejante,

pero hasta la fecha no ha sido observado en los enfermos con pericarditis aguda y derrame pericardíaco.

Preséntanse cuatro casos de pericarditis constrictiva en que se obtuvieron electroquimogramas de dicha índole. En un quinto enfermo, con adherencia pleuropericardíaca, los electroquimogramas obtenidos cerca de las adherencias mostraron el mismo aspecto.

El reconocimiento de la constricción pericardíaca, cuando no se sospecha su presencia, representa uno de los beneficios derivados del empleo sistemático de la electroquimografía, además de la roentgenoscopia, en los cardiópatas.

Retroperitoneal Emphysema from Perforation of an Intraperitoneal Viscus

GORDON J. CULVER, M.D., and JOSEPH P. CONCANNON, M.D.
Buffalo, N. Y.

THE ROENTGENOLOGIC aspects of perforation of the duodenum into the retroperitoneal tissues have been discussed in previous reports from this department (1, 2). A case with the typical appearance of perforation of the gastro-intestinal tract into the retroperitoneal tissues is presented here because of the unusual nature of the pathological process involved.

A 74-year-old white male was admitted to the Buffalo General Hospital, June 22, 1949, with severe lower abdominal pain of an hour duration. This pain became generalized throughout the entire abdomen. There was a history of both bloody and tarry stools and of moderate weight loss over the previous six months.

The patient appeared to be acutely ill. The temperature on admission was 102°, pulse 100. The abdomen was tense, and there were generalized abdominal tenderness and spasm. Rebound tenderness was elicited. Peristaltic sounds were not heard.

Plain roentgenograms of the abdomen, in the supine, upright, and left lateral decubitus projections, revealed air in typical retroperitoneal location, outlining the psoas shadows bilaterally and the kidney and suprarenal gland on the left. The air had spread between the diaphragm and the peritoneum bilaterally. Its distribution did not change in the lateral decubitus or upright position. There was no free air in the peritoneal cavity. A radiographic diagnosis of perforation of a retroperitoneal viscus was made.

An exploratory laparotomy was performed at once. When the peritoneal cavity was entered, there was an escape of approximately 1,000 c.c. of purulent exudate and fecal contents. The site of the perforation was found to be just above the recto-sigmoid, where a large gangrenous carcinoma was palpated. This had perforated and appeared to be causing a sloughing out of this area of the sigmoid. The liver and entire peritoneum were studded by metastatic carcinoma. A cecostomy was done.

Despite supportive measures and antibiotic therapy, the patient did not improve. He died June 28, 1949.

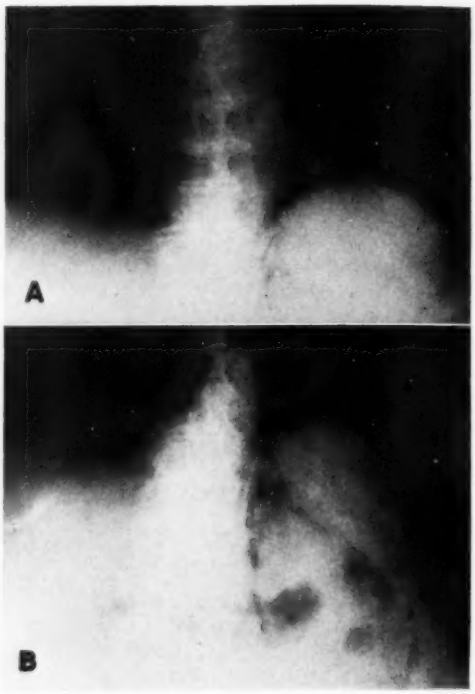


Fig. 1. A. Air is distributed over the upper pole of the left kidney and around the adrenal gland, and streaks of air are seen between the leaf of the diaphragm and the parietal peritoneum, bilaterally.
B. Obvious retroperitoneal distribution of air around left kidney and adrenal gland.

Unfortunately, autopsy permission could not be obtained.

Certain portions of the gastro-intestinal tract are not covered posteriorly with peritoneum, and are in direct contact with retroperitoneal tissues. These are the second, third, and fourth portions and a part of the first portion of the duodenum. The ascending and descending colon have a peritoneal covering only anteriorly and laterally, although occasionally they are surrounded by serous membrane and are

[1] From the Department of Roentgenology, Buffalo General Hospital, Buffalo, N. Y. Accepted for publication in August 1949.

attached to the posterior abdominal wall by an ascending or descending mesocolon. A perforation of the gastro-intestinal tract at these points, which are free of peritoneum posteriorly, will favor the appearance of retroperitoneal emphysema. This mechanism will not explain the retroperitoneal distribution of air in this case, and some other explanation must be sought.

to assume that the sigmoid perforated posteriorly into its mesocolon. Gas then dissected its way through the mesocolon to retroperitoneal structures. The sloughing gangrenous sigmoid would permit perforations both into the peritoneal cavity and into the mesocolon.

In the differential diagnosis of retroperitoneal emphysema demonstrated radiographically, we must no longer consider

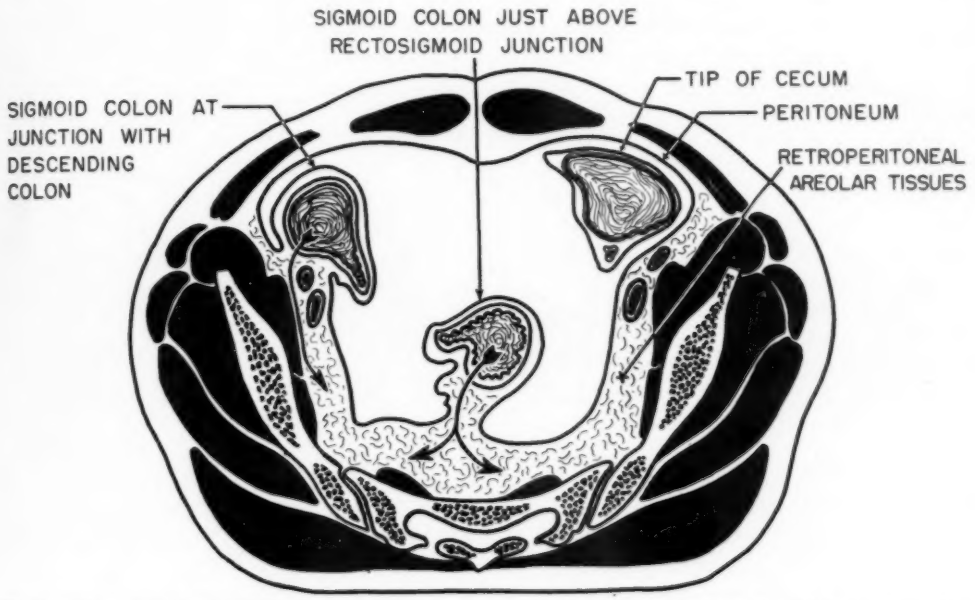


Fig. 2. Diagrammatic representation of the gastro-intestinal tract at the level of the third sacral vertebra. Arrows indicate the pathways by which gas from the lumen of the sigmoid may reach the retroperitoneal space.

The mesenteries are broad folds of peritoneum which suspend and connect both large and small bowel to the posterior wall of the abdomen. Between their layers are the blood vessels, nerves, lacteal vessels, and lymph nodes of the various portions of the intestinal tract which they support. The roots of the mesenteries, because of their loose structure, provide a plane through which air may dissect its way to the retroperitoneal structures. Figure 2 is a diagrammatic representation of the connection of the mesentery to the retroperitoneal structures.

To explain the retroperitoneal emphysema in the case presented, it is necessary only perforation of those portions of the gastro-intestinal tract which are free of peritoneum posteriorly. A lesion of the large or small bowel may rarely perforate into its mesentery, and thus give rise to air in the retroperitoneal tissues.

SUMMARY

A case of perforation of carcinoma of the sigmoid into its mesentery, with roentgen demonstration of retroperitoneal air, has been presented. While this is undoubtedly an unusual occurrence, it indicates that retroperitoneal emphysema may result from perforation of any portion of the gastro-intestinal tract.

REFERENCES

1. JACOBS, E. A., CULVER, G. J., AND KOENIG, E. C.: Roentgenologic Aspects of Retroperitoneal Perforations of the Duodenum. Radiology **43:** 563–571, December 1944.

2. KOENIG, E. C., AND CULVER, G. J.: Retroperitoneal Perforation of the Duodenum. Report of a Case. Radiology **48:** 164–167, February 1947.

Buffalo General Hospital
Buffalo 3, N. Y.

SUMARIO

Enfisema Retroperitoneal Debido a Perforación de Víscera Intraperitoneal

El caso presentado es de perforación por un carcinoma de la S ilíaca en el mesenterio de ésta, con descubrimiento roentgenológico de aire en el espacio retroperitoneal. Supónese que el gas se abrió camino hasta el retroperitoneo a través de algún tejido flojo del mesocolon. Si bien ésta es una causa rara de enfisema retroperitoneal, indica que el último puede ocurrir no sólo a consecuencia de perforación de las partes del tubo gastrointestinal desprovistas de peritoneo atrás, sino de perforación de cualquier porción del intestino grueso o delgado.

Clinical Studies of the Use of Emulsion of Ethyl Iodophenylundecylate (Pantopaque)[1]

EVERETT L. PIRKEY, M.D., EDSEL S. REED, M.D., and WILLIAM H. SMITH, M.D.
Louisville, Ky.

THE PURPOSE OF this paper is to review the development of one of the newer contrast media and to report upon its clinical application in studies of various types.

Strain, Plati, and Warren (1), at the University of Rochester, made a study of iodinated organic compounds with the object of developing an absorbable, insoluble contrast medium for use in radiographic diagnosis. Of the preparations investigated, ethyl iodophenylundecylate, a mixture of isomers obtained by the addition of iodobenzene to ethyl undecylate in the presence of aluminum chloride, seemed to fulfill most of the requirements. This work was reported in 1942, and the new preparation, containing 30.5 per cent iodine, was given the name "pantopaque" (2).

Early in the course of work with the new medium it was observed that stable aqueous emulsions were easily obtained. Such emulsions were shown experimentally to mix with tissue fluids and to have the property of coating and adhering to mucosa (3), which suggested the possibility of their use as a diagnostic aid in the visualization of sinuses, fistulas, and certain body cavities.

To form the emulsion a 50 per cent mixture by volume of ethyl iodophenylundecylate with water, containing a surface active agent, is passed several times through a homogenizer. The emulsion is milky white in color. On standing for several hours, it separates into a lower milky phase and a clear upper aqueous phase, which, however, are easily mixed by shaking. The oil droplets are on the order of 1.5 to 3.5 microns (3).

In experimental studies with dogs and other animals, satisfactory results were obtained with the emulsion in retrograde pyelography, cystography, urethrography, cholangiography, and bronchography. Salpingography was also attempted, but the medium failed to pass through the fallopian tubes, though these later proved to be patent in 2 of the 5 animals used for the experiment.

Ethyl iodophenylundecylate (pantopaque), having been proved by animal experiments to be relatively non-toxic, was first used clinically in myelography in 1940. The oil has been used for that purpose at this institution (University of Louisville) for about eight years and has proved superior to iodized poppyseed oil for reasons well known (2, 4, 5).

The process of emulsification leads to an increase in surface area of the compound and this, of course, increases the toxicity. The intraperitoneal lethal dose for mice is not markedly affected, but the emulsion is considerably more toxic for rats than the oil (3). Amounts up to 1.0 c.c. per kilogram of body weight of the 50 per cent emulsion were injected intravenously in dogs without immediate or subsequent ill effects.

In our clinical experience we have observed toxic reactions that could be attributed to the emulsion on two occasions only. In both instances severe coughing attacks and bronchial spasm occurred following the injection of the emulsion into the bronchial tree for bronchography.

CLINICAL STUDIES

At the time of this writing there has appeared in the literature a single report (6) of the clinical use of the emulsion of ethyl iodophenylundecylate, namely for the demonstration of empyema cavities, in 8 cases. The medium was easily injected into the

[1] From the Department of Radiology, University of Louisville, School of Medicine, Louisville, Ky. The material used in this work was supplied by Dr. H. Sydney Newcomer of E. R. Squibb & Co. Paper accepted for publication in July 1949.

Fig. 1. Cholangiogram obtained with pantopaque emulsion, showing considerable dilatation of the common and biliary ducts. A sinus tract is present and a large radiolucent stone is outlined by the emulsion. A smaller stone near the ampulla of Vater prevents entrance of the emulsion into the duodenum.

cavities and was distributed to all parts by the normal respiratory movements. It appeared to have a tendency to collect on a coagulum of pus, but this apparently did not interfere with delineation of the cavity. Most of the medium is removed without difficulty by saline lavage, and the small amount remaining is absorbed in a few days.

At this institution we have used the emulsion clinically in 63 examinations on 39 patients, for cholangiography, bronchography, urethrography, eosphageal studies, and for visualization of sinuses, fistulas, and diverticula.

Cholangiography: Cholangiography has been performed on 35 occasions in 14 patients. In 5 cases the cholangiograms were obtained during operation. The usual procedure is as follows: 20 c.c. of sterile normal saline is first injected through the outer end of the T-tube, after which 10 c.c. of the emulsion is injected slowly under fluoroscopic guidance. Spot films are taken as indicated, the remaining 10 c.c. of emulsion is then injected, and multiple exposures are made.

The emulsion is quite opaque and can easily be followed fluoroscopically. Its low viscosity and miscibility afford entirely adequate delineation of the common and other biliary ducts. Calculi are demonstrated as an area of radiolucency surrounded by the opaque emulsion. After most of the emulsion has entered the duodenum, an adherent coating still covers the mucosa. No evidence of toxicity or local irritation has been observed in any patient.

Bronchograms and Tracheal Studies: Bronchograms and tracheal studies were attempted in 6 examinations on 5 patients. The patients were prepared in the usual manner and the emulsion was injected into the tracheal tree after adequate topical anesthesia. Despite optimistic views based on bronchography in experimental animals, our results were uniformly less satisfactory than with ordinary iodized poppyseed oil. In 2 of our patients, as noted above, severe reaction developed, consisting of violent coughing and bronchial spasm. The reactions experienced may be due to the absorbability of the medium in the tracheal tree, leading to iodine intoxication, or as has been postulated, the size of the oil droplets in the emulsion may have some peculiar irritating effect. Because of the fluidity of the medium, it seems to be more easily expectorated than iodized poppyseed oil. A new lot of the emulsion with particles of different size has been obtained for bronchography, and the study is continuing.

Cystography: The preparation has been used in 2 cases in suspected strictures of the cavernous urethra. The emulsion adequately demonstrated the strictures and no reaction occurred.

Miscellaneous Studies: We have used the material also for demonstrating branchial cleft sinuses, for demonstration of the ductal system of the breasts, tracheo-esophageal fistulas, small intestinal fistulas, appendiceal fistulas, pulsion diverticula of the esophagus, facial sinuses, and empyema cavities.

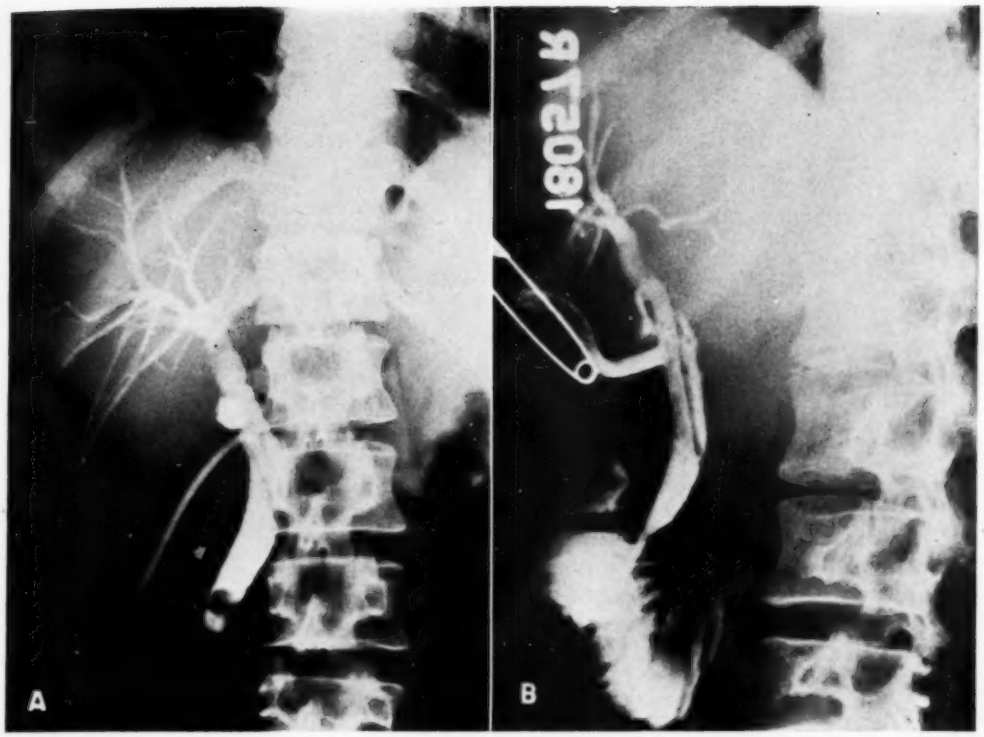


Fig. 2. A. Cholangiogram obtained with pantopaque emulsion, showing the outline of two radiolucent calculi causing obstruction near the ampulla of Vater. There is distention of the biliary ducts. B. Cholangiogram of same patient after removal of the calculi, showing entrance of the emulsion into the duodenum.

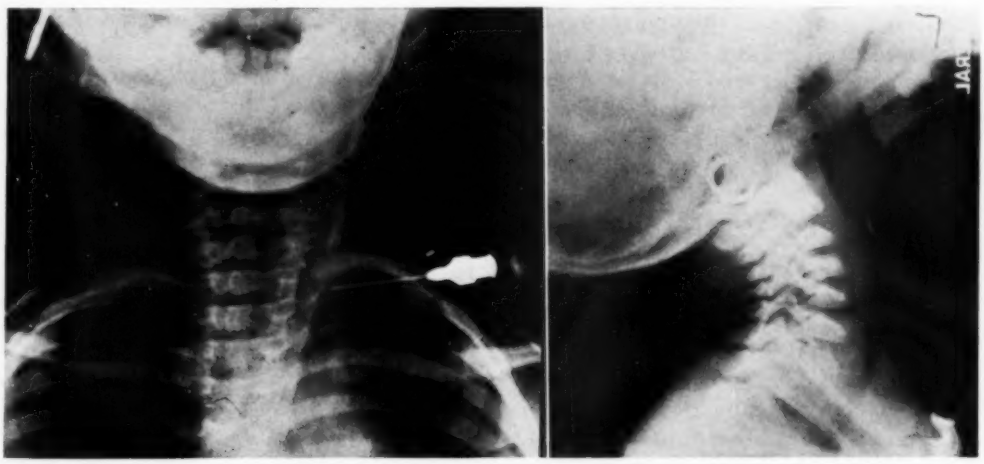


Fig. 3. Anteroposterior and lateral views of a left branchial cleft sinus obtained following injection of pantopaque emulsion, showing the sinus extending posterosuperiorly.

Fig. 4. Urethrogram, showing a stricture of the cavernous urethra outlined by pantopaque emulsion.

In these various studies, the results obtained were satisfactory and were superior to those obtained with iodized poppy seed oil. The material seems to lend itself particularly well to this miscellaneous type of work. It is easily handled and can be injected through a 20-gauge or smaller needle with ease. It is miscible with tissue fluids and will adequately delineate sinuses and the true extent of empyema cavities. It seems also to adhere to mucous membrane to a considerable degree.

The emulsion has been used sparingly in examination of the upper gastro-intestinal tract and colon and seems to offer no particular advantage over commonly used materials except in special mucosal studies and demonstration of tracheo-esophageal and intestinal fistulas.

CONCLUSION

The emulsion of ethyl iodophenylundecylate (pantopaque) seems to offer several advantages over the contrast media now in use:

1. Ability to adhere to mucosa.
2. Low viscosity.
3. Low surface tension.
4. Miscibility with tissue fluids.
5. Good radiopacity.

The fact that the emulsion is miscible with tissue fluids should help to avoid the false results that are sometimes obtained with iodized oils. The medium is of considerable opacity and apparently has a low toxicity, which, however, should be further investigated.

Fig. 5. Pantopaque emulsion study of breast duct in cystic mastitis, with deviation of the duct due to a cyst.

While these studies are far from being conclusive, we feel that, with the qualities mentioned above, this emulsion may well make a permanent place for itself as a contrast medium of considerable value in radiographic diagnosis.

University of Louisville
Louisville 2, Ky.

REFERENCES

1. STRAIN, W. H., PLATI, J. T., AND WARREN, S. L.: Iodinated Organic Compounds as Contrast Media for Radiographic Diagnoses. I. Iodinated Aracyl Esters. J. Am. Chem. Soc. **64:** 1436–1440, June 1942.

2. STEINHAUSEN, T. B., DUNGAN, C. E., FURST, J. B., ET AL.: Iodinated Organic Compounds as Contrast Media for Radiographic Diagnoses. III. Experimental and Clinical Myelography with Ethyl Iodophenylundecylate (Pantopaque). Radiology **43:** 230–234, September 1944.

3. CHALECKE, W. E., JONES, G. E., MILLER, L. L., ET AL.: Iodinated Organic Compounds as Contrast Media for Radiographic Diagnoses. VI. Experi-

mental Studies on Emulsions of Ethyl Iodophenylundecylate (Pantopaque). Radiology **49:** 131–136, August 1947.

4. RAMSEY, G. H., FRENCH, J. D., AND STRAIN, W. H.: Iodinated Organic Compounds as Contrast Media for Radiographic Diagnoses. IV. Pantopaque Myelography. Radiology **43:** 236–240, September 1944.

5. SCOTT, W. G., AND FURLOW, L. T.: Myelography with Pantopaque and a New Technic for Its Removal. Radiology **43:** 241–249, September 1944.

6. GEORGE, M. P., MAHONEY, E. B., PEARSE, H. E., AND STRAIN, W. H.: Iodinated Organic Compounds as Contrast Media for Radiographic Diagnoses. VII. Visualization of Empyema Cavities with the Aid of Ethyl Iodophenylundecylate Emulsion. Radiology **49:** 137–141, August 1947.

SUMARIO

Estudios Clínicos del Empleo de la Emulsión de Yodofenilundecilato Etílico (Pantopaco)

Cuando se pasa varias veces por un homogeneizador una mezcla al 50 por ciento por volumen de yodofenilundecilato etílico (pantopaco) con agua, conteniendo un agente artificial activo, obtiénese una emulsión blanca lechosa, según han comunicado otros investigadores. Los AA. han usado clínicamente esa preparación en 63 exámenes de varios géneros, incluso colangiografía, broncografía, uretrografía, estudios esofágicos y observación de fístulas y divertículos. Las ventajas de la misma consisten en su capacidad para adherirse a la mucosa, poca viscosidad, baja tensión superficial, miscibilidad con los humores orgánicos y buena radioopacidad. La toxicidad parece ser escasa, pero están indicados estudios ulteriores desde este punto de vista. Para la broncografía y los estudios gastrointestinales, salvo para el hallazgo de fístulas, la emulsión no ofrece mayor ventaja sobre otros medios empleados más habitualmente. La sustancia parece prestarse en particular para la observación de fístulas, cavernas empiemáticas y divertículos.

New Bone Formation Associated with Direct Extension from Lymph Node Metastases to Bone in Infiltrating Carcinoma of the Bladder

Report of a Case[1]

JOHN M. PHILLIPS, M.D.

THE INCIDENCE of direct extension to bone from a primary carcinoma of the bladder or metastatic lymph nodes is unknown. Graves and Militzer (2) observed a right pelvic mass, hard, with irregular areas of decreased density, but no new bone production, in the rim of the pelvis, which they agreed probably represented direct extension rather than a metastasis. Zeman (6) reported metastases to the abdominal lumbar lymph nodes, which in many places had invaded the bone directly, without new bone formation. Cunningham (1), in an analysis of 411 autopsied cases of bladder tumor collected from various sources, found involvement of the pelvic bones, presumably by direct extension, in 6 cases with visceral and lymph node metastases. Spooner (5), in his study of metastases from carcinoma of the bladder, placed bone involvement tenth in order of frequency, which he thought supported the opinion that invasion of bones except by direct extension is an uncommon feature of these neoplasms.

A knowledge of the lymphatics of the bladder is essential for an understanding of the method of dissemination. According to Powell (4), the lymphatic ducts arising in the submucosa run directly as small collectors to the adventitia covering the bladder, where they are joined by lymphatic capillaries from the peritoneum. From the anterior wall the collector lymphatics run along the course of the obliterated hypogastrics on either side of the midline toward the neck of the bladder near the origin of the ureter, where they turn laterally. The posterior lymphatics follow a less constant path. Some course laterally without uniting with trunks from other parts of the bladder, while others join those from the anterior wall. The anterior lymphatics do not anastomose across the midline, while the posterior lymphatics do.

Fig. 1. Sept. 10, 1947. The bones of the pelvis appear normal.

Both the anterior and posterior lymphatics go laterally to the internal and middle chains of the external iliac groups (3), rarely to the nodes of the external chains. Occasionally common iliac, lateral sacral, sacral promontory, or hypogastric nodes receive lymph collectors directly.

[1] From the Department of Radiology, Hospital of the University of Pennsylvania, Philadelphia, Penna. Accepted for publication in August 1949.

Thus the constantly occurring regional nodes are located on the posterior and lateral walls of the pelvic cavity and on the rim of the pelvis.

The following case of infiltrating carcinoma of the bladder is presented as an unusual manifestation of direct extension from metastases to the middle chain of the external iliac group of nodes into the rim of the pelvis, with new bone formation.

Fig. 2. Nov. 4, 1947. An osteoblastic process is seen along the inner rim of the left ilium, with bone spicules perpendicular to the bone. This was before irradiation therapy was begun.

CASE REPORT

F. C., a 64-year-old white male, was treated on the Urological Service, Hospital of the University of Pennsylvania. On admission, Aug. 9, 1945, he gave a history of experiencing a dull, gnawing, hypogastric pain before urinating, nocturia, and the passage of chocolate-colored urine. Cystoscopy revealed a flat, infiltrating tumor the size of a half-dollar, involving the left portion of the bladder above the left ureteral orifice. Biopsy studies indicated an infiltrating carcinoma of the bladder, Grade III. A partial cystectomy was done, completely removing the tumor, and suspicious areas about the vesical orifice were fulgurated. No evidences of metastases were encountered outside the bladder.

Fig. 3. Roentgenogram made ten days after completion of irradiation. Further bone production along the pelvic brim is to be noted.

Three weeks later acute retention developed and the suprapubic incision ruptured, producing a fistula. On cystoscopy, a large calcareous body was discovered and removed. The left ureteral orifice could not be seen. Nine weeks following operation, numerous papillary recurrences posterior to the left ureteral orifice were fulgurated. On two subsequent occasions fulguration was done for small papillary projections on the left lateral wall and along the dome of the bladder, extending down to the vesical orifice.

Eight months postoperatively a papilloma in the vault was fulgurated and an area of infiltrating tumor along the left lateral wall and about the left ureteral orifice was implanted with eight radon seeds. Twice a left pyelonephritis developed due to slough. There was an inflammatory reaction about the ureteral orifice.

In June 1947, the patient began to experience a knife-like pain in the left inguinal region, often extending down to the left knee. A roentgen examination of the pelvic bones showed no evidence of

metastases and cystoscopy revealed only bladder scarring, with no recurrence. The left hip pain was thought to be referred sclerotome pain and irritation of the nerves of L-2, 3, and 4 distribution.

A urogram (Fig. 1) obtained on Sept. 10, 1947, showed normal pelvic bones and delayed excretion by the right kidney. The left kidney was not visualized.

Two months later a large mass in the left lower quadrant was palpated, presumably metastatic iliac lymph nodes. The pelvic bones (Fig. 2) at this time, Nov. 4, 1947, showed roentgenographic evidence of an osteoblastic process, with bone spicules perpendicular to the bone along the inner rim of the left ilium. A tumor dose of 2,360 r was delivered to the mass through an anterior and a posterior left lower quadrant port, 15 × 20 cm., from Nov. 11 to Dec. 2, 1947, with the following factors: 200 kv., 15 ma., 1.0 mm. Al plus 0.5 mm., Cu filtration, h.v.l. 1.0 mm. Cu, 50 cm. target-skin distance, 200 r in air to one port daily. Ten days following completion of irradiation, the pelvis (Fig. 3) showed rarefaction, with further bone production medially along the left internal pelvic brim, probably due to extension from the large pelvic mass. The new bone was distributed radially, a noteworthy feature. The patient lived for another eight months.

SUMMARY

An unusual case of new bone formation associated with direct extension into the pelvis from lymph node metastases is reported. The primary lesion was an infiltrating carcinoma of the bladder. The metastasis was demonstrated roentgenographically before irradiation and shortly after a large pelvic mass became palpable.

Department of Radiology
Hospital of University of Pennsylvania
Philadelphia 4, Penna.

REFERENCES

1. CUNNINGHAM, J. H.: Tumors of the Bladder. J. Urol. **25:** 559–587, 1931.
2. GRAVES, R. C., AND MILITZER, R. E.: Bone Metastases from Carcinoma of the Urinary Bladder. J. Urol. **31:** 769–789, 1934.
3. PARKER, A. E.: Lymph Collectors from the Urinary Bladder and Their Connections with the Main Posterior Lymph Channels of the Abdomen. Anat. Rec. **65:** 443–460, 1936.
4. POWELL, T. O.: Studies in the Lymphatics of the Female Bladder. Surg., Gynec., & Obst. **78:** 605–609, 1944.
5. SPOONER, A. D.: Metastasis in Epithelioma of Urinary Bladder. Tr. Am. A. Genito-Urin. Surgeons **27:** 81–89, 1934.
6. ZEMAN, E. D.: Bone Metastases with Primary Carcinoma of the Urinary Bladder. J. Urol. **35:** 646–651, 1936.

SUMARIO

Neoostogenia Asociada a Difusión Directa de las Metástasis Ganglionares al Hueso en el Carcinoma Infiltrante de la Vejiga. Comunicación de un Caso

Comunícase un caso extraño de nueva osteogenia asociada a difusión directa a la pelvis de las metástasis de ganglios linfáticos. La lesión primaria era un carcinoma infiltrante de la vejiga urinaria. La metástasis fué descubierta roentgenográficamente antes de la irradiación y poco después se volvió palpable una gran tumefacción pelviana. Una característica notable fué la distribución radial del hueso nuevo.

New Trends in Radiographic Screening Technics Utilizing Schmidt Optical Systems and High-Speed Development[1]

RUSSELL H. MORGAN, M.D.

Baltimore, Md.

SINCE THE EARLIEST application of radiological methods to the field of medicine, there has been an accelerating evolution of technics and apparatus by which clinical problems may be studied with greater and greater detail. Although this trend in the development of diagnostic radiology is unquestionably sound, it should be realized that it is taking place at some expense to the radiologist and patient. The highly technical nature of present-day radiology has removed the radiologist to a considerable degree from the intimate clinical contact that must be his if he is to perform in the most effective way. As a result, there are many radiologists who have become alarmed at the isolation from clinical affairs that has been imposed by our almost complete dependence on an extensive and complicated technology.

There is one other problem that our course of specialization in radiology has created. The cost of many radiological services to the patient has risen to the point where persons in the middle and lower income groups find it difficult to pay for such services. This is indeed unfortunate, for it is occurring at a time when several national groups are exerting considerable pressure to relieve the medical profession of its logical control over medical economics.

In view of the foregoing the question that must inevitably arise is what can be done to correct these problems without giving up the many advantages which have been achieved by our high level of radiological development. By lowering the quality of the service which radiologists are providing, the cost of radiological procedures could doubtless be reduced to some extent. However, there are few who would advocate such a solution. Furthermore, such a scheme would probably isolate the radiologist even further from his clinical colleagues.

To those of us who have been working extensively in the field of photofluorography for several years, it has seemed that the ultimate solution to the radiological problems which we have been citing may possibly lie in the application of photofluorographic methods to general clinical medicine. Photofluorographic apparatus may now be made sufficiently compact that it may be installed without difficulty in the clinics or on the wards of a hospital in close relation to the patients who need its services. If the radiologist follows his apparatus to the clinic or ward, he will find that he has achieved much of the close contact with his clinical colleagues that he is seeking.

In addition to the benefits of photofluorography to the radiologist, it has many advantages for the patient as well. Photofluorography is an inherently inexpensive procedure from a technical standpoint. The cost of supplies is low. If the films are filed in the histories of the patients, the need of costly filing services which are characteristic of departments of radiology today is virtually eliminated. From thoroughgoing cost analyses of photofluorographic examinations of the chest and of the stomach made in the Johns Hopkins Hospital in recent years, it appears that the technical cost of a photofluorographic exposure, including technical and clerical wages, amortization and servicing charges on equipment, and charges for supplies, floor space and miscellaneous facilities,

[1] From the Department of Radiology, The Johns Hopkins University and Hospital, Baltimore, Md. Presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

ranges from thirty to sixty cents, depending on the number and nature of the examinations performed each day. Such a cost is less than 10 per cent of that incurred in the production of a conventional radiographic film made in the Department of Radiology.

If photofluorography yields such fundamental and far-reaching benefits to both the radiologist and patient as have just been cited, one may reasonably ask why the method has not found wide application in clinical medicine before this time. The answer to this question may be found in a small but important number of technical problems that have faced photofluorographic procedure. For many years, the radiation to which a patient is exposed during photofluorography has been approximately twenty times that needed in conventional radiography. Indeed, the required amount of radiation for the production of photofluorographic films of satisfactory density has been so great that only the chest and extremities could be examined by the method without danger of delivering an excessive amount of radiation to the patient. Fortunately, this problem has been effectively solved in recent years by the use of Schmidt optics (more properly called reflector-type optics) in photofluorographic cameras (1). These lenses deliver to the film much more light than that which may be reasonably obtained with the conventional refractor-type lenses used heretofore. As a result, it has been shown (2) that photofluorographic apparatus using reflector-type lenses delivers little more radiation than conventional radiographic equipment.

Although reflector-type optics have removed one of the serious problems of photofluorography, there is one difficulty with the system that remains unsolved. The clarity or quality of photofluorographic films has been significantly lower than that of conventional roentgenograms. Even though Birkelo *et al* (3) have shown that photofluorographic films are as accurate as conventional radiography in the detection of pulmonary tuberculosis, there is a feeling, among most radiologists, and justifiably so, that the diminished quality of photofluorographic films may render them somewhat poorer diagnostically in many pathological processes.

The differences between photofluorographic and conventional films in their abilities to record detail have been studied quantitatively by Van Allen (4). He has shown by rigorously controlled investigation that the resolution of conventional radiographic film exposed with intensifying screens is in the neighborhood of ten lines per millimeter. On the other hand, photofluorograms made with any one of several pairs of commercially available photofluorographic screens and 70-mm. films, and with either a Fairchild camera employing an Eastman Ektar lens or a Helm camera employing Schmidt optics, yield a resolution of 2.5 lines per millimeter when enlarged to the natural size of the image appearing on the screen. Thus, the clarity of photofluorograms is inferior by a factor of four times when compared to conventional radiography. It is not surprising, therefore, that this wide difference in resolution has reduced the radiologist's confidence in photofluorographic procedures.

The cause of the low resolution in photofluorographic films may be found in the optical systems heretofore employed in photofluorographic cameras. Present-day fluorescent screens used in photofluorography have inherent resolutions ranging from 5 to 9 lines per millimeter. Also, commercially available 70-mm. photofluorographic films have inherent resolutions of the order of 8 lines per millimeter when the images are enlarged to a 16 × 16-inch field size, the size of standard photofluorographic screens. These resolution values for screens and films, then, are considerably higher than that of a photofluorographic film made in combination with a conventional fluorescent screen and a present-day camera. Since it is known that the resolution of an optical system is governed almost entirely by the element in the system which has the poorest resolution, it must be surmised, therefore, that

the lens rather than the screen and film of a photofluorographic system is the factor which reduces the resolution to 2.5 lines per millimeter. Actually, if the inherent resolutions of Fairchild and Helm cameras are measured, the values will be found to be only slightly greater than 2.5 lines per millimeter at the screen.

From the resolution values for screens, films, and lenses given in the foregoing paragraph, it is evident that, if the resolution of photofluorographic lenses could be raised by the order of four times, photofluorograms might be obtained that are closely similar to conventional radiographs in quality. Work is already in progress to achieve this objective. Bouwers (5) in Holland has produced a photofluorographic camera that has a resolution of 5 lines per millimeter at the screen; this is twice the resolution of previously available cameras and accordingly its clarity of reproduction should be considerably better than that provided by previously available photofluorographic cameras. Indeed, the Bouwers camera should go a long way toward making up the difference between present-day photofluorograms and conventional roentgenograms.

The Bouwers camera employs reflector-type optics and has a speed rating similar to that of the Helm camera which we have been using for the past year or so. It has achieved its high resolution, therefore, at no expense in speed. In view of this and other developments which we can expect in the future, it appears that the disadvantage which photofluorographic films have had when compared to conventional films will soon be overcome and the diagnostic quality of the two media will be closely identical.

In addition to advances in the design of optical systems, developments have recently occurred in the field of film-processing which, it is anticipated, will soon solve many of the problems now encountered in the development, fixing, washing, and drying of photographic films. Although these new technics do not seem applicable to the processing of large-size radiographs, they do seem applicable to photofluorographic films. A system for rapidly processing photographs of radar screens has recently been developed for the U. S. Army. If such a system were applied to photofluorography, together with the finest possible reflector-type optics, we would have at hand a clinical radiological tool of far-reaching value. At the present time, work is in progress to achieve this objective. If this research is successful, we hope to place many photofluorographs in the clinics and on the wards of our hospital. With such apparatus, the radiologists of our department will work in intimate contact with their clinical colleagues in other specialties. At long last, the placement of the radiologist in the very center of clinical activity will be an accomplished fact. Furthermore, he will have at his disposal films of excellent quality for use in consultation with the referring physician soon after the patient is radiographed. Also, these films will be made at a small fraction of present-day cost to the patient.

Under such a program it is anticipated that the radiologists will be reimbursed on a fee-for-service basis identical to that enjoyed by their clinical colleagues. Thus, one of the perplexing problems of radiological economics, namely, the payment of the radiologist for his services, will be overcome not only to the satisfaction of the patient and hospital but to the radiologist as well.

It is not proposed, of course, that all radiological procedures in the clinics and on the wards be performed with these new technical developments. Many procedures, especially those of a special nature, will continue to be carried on in our central department. However, it will be the radiologist in the clinic who will bring the patient to the central department for further work-up when necessary. In such a program, the radiologist will occupy a position in his relation to the central department similar to that of the surgeon in his relation to the operating room. We anticipate that such a relationship will be a sound one, which will do much to better the standards of radiological practice.

BIBLIOGRAPHY

1. MORGAN, R. H., GOULD, D. M., AND VAN ALLEN, W. W.: Two Danish Photofluorographic Cameras of the Original Schmidt Type. Am. J. Roentgenol. **59:** 416–419, 1948.
2. ROACH, J. F., SLOAN, R. D., AND MORGAN, R. H.: Detection of Gastric Carcinoma by Photofluorographic Methods. Part II. Equipment Design. Am. J. Roentgenol. **61:** 188–194, 1949.
3. BIRKELO, C. C., CHAMBERLAIN, W. E., PHELPS, P. S., SCHOOLS, P. E., ZACKS, D., AND YERUSHALMY, J.: Tuberculosis Case-Finding: A Comparison of the Effectiveness of Various Roentgenographic and Photofluorographic Methods. J. A. M. A. **133:** 359–365, 1947.
4. VAN ALLEN, W. W., Personal communication. See also VAN ALLEN, W. W., and MORGAN, R. H.: Measurement of Resolving Power of Intensifying Screens. Radiology **47:** 166–174, 1946.
5. BOUWERS, A.: Achievements in Optics. Elsevier Publishing Co., Inc., 1946.

Department of Radiology
Johns Hopkins Hospital
Baltimore 5, Md.

SUMARIO

Nuevas Tendencias en las Técnicas Radiográficas Utilizando los Aparatos Opticos de Schmidt y la Revelación a Alta Velocidad

Dos problemas con que tropieza la especialidad radiológica hoy día son: (1) la tendencia de los procedimientos pertinentes a limitar, por su naturaleza tan técnica, la actividad clínica del radiólogo, y (2) el elevado costo de los servicios radiológicos para el enfermo. Parece que la solución de dichos problemas puede radicar en el mayor empleo de las técnicas roentgenofotográficas. Los aparatos roentgenofotográficos pueden instalarse sin dificultad en las clínicas o salas de un hospital, de modo que el radiólogo queda en contacto más íntimo con sus colegas clínicos y disminuyen considerablemente los gastos técnicos.

El empleo más extenso de la roentgenofotografía se ha vuelto posible gracias a varios avances recientes. El uso de la óptica de Schmidt (con lentes de tipo reflector) en las cámaras roentgenofotográficas rebaja la cantidad de radiación requerida para la producción de radiografías satisfactorias y por lo tanto acorta la excesiva exposición del paciente, en tanto que labor ahora en camino promete acrecentar la resolución de las lentes roentgenofotográficas, facilitando así detalles comparables a los de las radiografías corrientes. Por fin, ha habido recientes desenvolvimientos en el campo de la preparación de las películas fotográficas que tienen aplicación especial a la roentgenofotografía.

A New Type of X-Ray Cassette Cabinet[1]

GEORGE LEVENE, M.D., and LT. COL., CHARLES B. PERKINS, M.C.

Boston, Mass.

THE USUAL method of storing cassettes in the radiographic room is to keep them in a lead-lined chest on the floor. The disadvantages of such a chest are known to all who have occasion to use one. The cassette cabinet here described was built in the hospital carpenter shop and has been in use for a number of years. We have found it so satisfactory that we have had two additional cabinets installed.

Essentially, the cabinet consists of a box covered with lead 1/16 inch thick, inside of a cabinet. There are two compartments, one for fresh films and the other for exposed films. Each compartment has sixteen shelves, or racks. Each rack consists of three rollers made of 3/4-inch round wooden dowel and spaced 4-1/4 inches apart. Cassettes, therefore, roll easily in and out of the cabinet. Backstops, made of 3/4-inch board covered with sponge-rubber, are provided for the upper twelve racks, and are so placed as to allow the proper size cassette to come to a stop. This permits the forward edge of the cassette to be grasped easily with the fingers as it projects over the roller. The lower four racks accommodate 14 × 17-inch cassettes, and the chest itself, covered with sponge-rubber, provides the back-stop. The distance between racks is 1-1/4 inches. The front of the cabinet is protected by lead-lined, self-closing doors, mounted on heavy spring hinges. This obviates possible accidental fogging of films through an open door.

Immediately below the cassette compartments are two sliding shelves on which the technician may rest a load of fresh or exposed cassettes. These disappear into the cabinet when not in use.

The cassette cabinet rests on a cupboard in which are stored radiographic cones, sandbags, and other accessories. The top of the cabinet provides a convenient place for fresh gowns, sheets, and pillow cases.

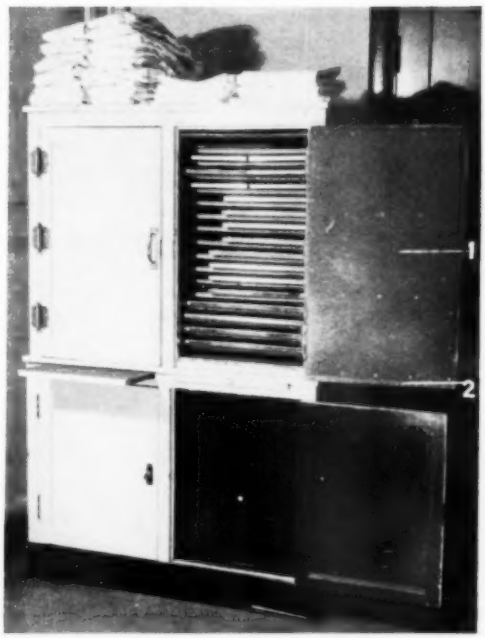


Fig. 1. Photograph of x-ray cassette cabinet. The compartment for fresh films is open. The door of the compartment for exposed films is shut. Each side will accommodate 20 cassettes of assorted sizes as shown. 1. Masonite. 2. Sheet lead 1/16 inch thick.

Each side of the cabinet will accommodate eight 8 × 10-inch cassettes, four 10 × 12-inch cassettes, four 11 × 14-inch cassettes, and four 14 × 17-inch cassettes.

Among the advantages of this cassette cabinet are the following:

(1) A cassette of any size can be identified and obtained instantly without the need of shuffling through a pile of mixed sizes.

(2) The cassette is reached without stooping or bending.

(3) The cassette slides easily off the rack.

[1] From the Department of Radiology, Massachusetts Memorial Hospitals, Boston, and Boston University School of Medicine. Accepted for publication in July 1949.

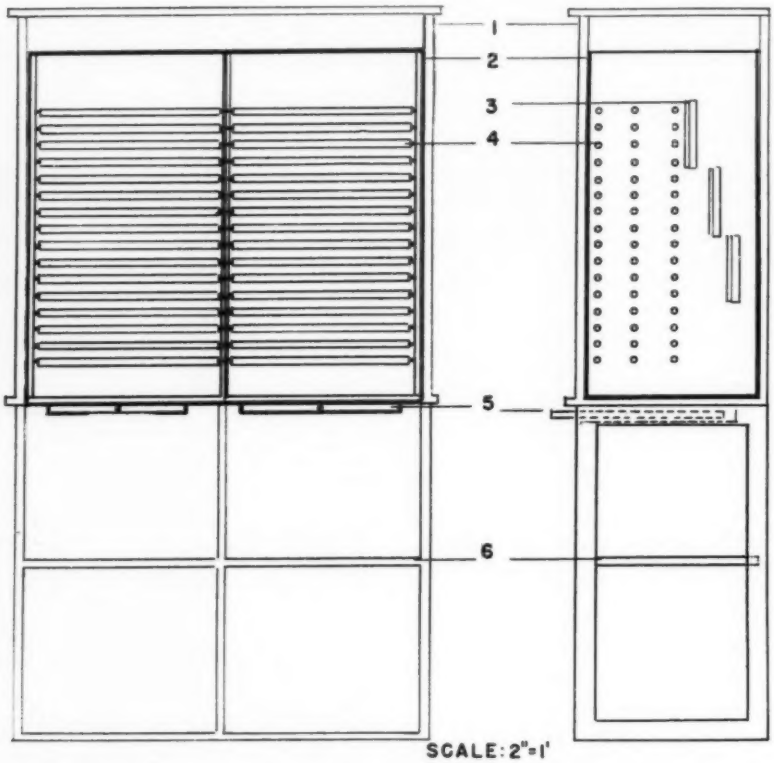


Fig. 2. Scale drawing of x-ray cassette cabinet showing important construction details. 1. Outer cabinet. 2. Sheet lead 1/16 inch thick. 3. Back-stop covered with sponge-rubber. 4. 3/4-inch round dowel. 5. Shelf. 6. Shelf in lower cupboard.

(4) Cassettes are not bruised.

(5) There is no possibility of double exposing. In each radiographic room, the right hand compartment of the cabinet contains fresh films, and the left hand compartment contains exposed films.

(6) A greater supply of cassettes can be kept in the radiographic room.

(7) Cassette life has been increased about 200 per cent.

It might be helpful to those desiring to build such a cassette cabinet to point out that the lead covering of the doors is apt to fly loose by force of momentum when the doors spring themselves shut. This is easily overcome by facing the lead with a sheet of masonite 1/4 inch thick, which is fastened by screws to the doors.

Our cabinets were built from 3/4-inch boards. They can, of course, be readily fabricated from sheet metal.[2]

750 Harrison Ave.
Boston 18, Mass.

[2] Detailed information may be obtained from the Metalcraft Company, Boston, Mass.

SUMARIO

Nuevo Armario-Chassis Radiográfico

El armario-chassis aquí descrito consta en el fondo de una caja forrada de plomo y colocada en un armario, que contiene dos compartimientos: uno destinado a películas nuevas y el otro a las expuestas. Cada uno contiene 16 anaqueles o gradillas

hechos de rodillos de madera. Los cuatro más bajos tienen espacio para chassis de 35 × 42.5 cm., en tanto que los de más arriba están provistos atrás de sostencillos de madera, recubiertos de caucho, y colocados de manera que acomoden chassis más pequeños.

El frente del armario está resguardado por puertas de cierre automático, forradas de plomo y montadas en gruesos goznes de resorte. Inmediatamente debajo de los compartimientos para chassis, hay dos estantes corredizos, y debajo de éstos se halla un aparador destinado a guardar conos radiográficos, bolsas de arena y otros accesorios.

Acquired Radioresistance of the Crypt Epithelium of the Duodenum[1]

MARGARET A. BLOOM, M.S.

Chicago, Ill.

THE DIFFERENT cells of the body show varying degrees of "natural" or "native" radioresistance. Any change from these levels, on the positive side, has been called acquired radioresistance. There is some evidence that the crypt epithelium of the small intestine shows such radioresistance. These cells, normally radiosensitive to x-rays (Regaud, Nogier, and Lacassagne, 1; Warren and Whipple, 2), seem to become less sensitive after repeated irradiation. Warren and Whipple (3), after irradiating the abdomens of dogs, reported: "When intervals of six days or longer supervene between x-ray doses we find little if any summation and at times even a suggestion of increased tolerance to subsequent x-ray exposures." Friedman and Warren (4), exposing rabbits to local irradiation with repeated doses of x-rays, 400 or 500 r each, described an initial inhibition of mitosis in the cells of the intestinal epithelium, followed by its reappearance despite continued application of radiation.

Observations reported by Pierce (5) on the gastro-intestinal tract of mice showed that repeated small doses of total-body roentgen irradiation produced an acquired radioresistance in the cells at the base of the intestinal crypts. After four daily doses of 80 r, epithelial cell death in the crypts of the duodenum was found to be at a maximum. There was less cell death after fourteen doses than after four, and after twenty and even thirty-five doses (1,600 and 2,800 r, respectively) the crypts were similar to those in controls. This suggested the desirability of using the duodenal crypt epithelium in further tests to measure radioresistance.

The studies reported here were planned to repeat the work of Pierce with more closely spaced intervals, particularly during the period of greatest sensitivity of the crypt cells, with observations of specimens a few hours following irradiation and after a longer interval to allow for recovery or further degeneration (Experiment A). The second part of the work (Experiment B) was an attempt to determine (*a*) against how large a dose of x-rays and (*b*) for how long a time the increased radioresistance would be effective.

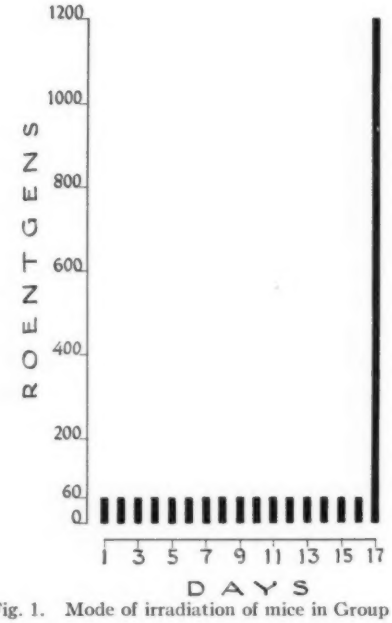


Fig. 1. Mode of irradiation of mice in Group 6.

MATERIALS AND METHODS

As CF1 mice were substituted for the ABC mice which served as the subjects of Pierce's experiment, and as the former had been shown by survival tests to be slightly more sensitive to irradiation than the ABC strain (Sacher, 6), it was decided to use a

[1] From the Biology Division, Argonne National Laboratory, Chicago, Ill. Accepted for publication in August 1949.

dosage of only 60 r per day instead of 80 r. The mice were divided into twelve groups as detailed below.

Experiment A: One hundred Carworth female mice weighing 15 to 20 gm. each were divided into four groups. All were maintained on a normal diet in stock cages in the laboratory for about four weeks and then transferred to small square cages, usually 12 mice to a cage. Eight of the mice were kept as untreated controls (Group 3) and the remaining 92 were exposed to roentgen radiation, 60 r daily. Exposures were made in the cages on the periphery of a square, 2 × 2 ft., on the floor of the x-ray room. The exposure time was twenty minutes; the dosage rate, 3 r per minute; kv., 200; ma., 15; filtration, 0.5 mm. Cu. plus 1.0 mm. Al.

Autopsies were done on 2 animals at three hours (Group 1), and on 2 at twenty-four hours (Group 2), after each exposure from two through eleven days, and then after every two or more exposures through thirty-five days. The mid-portion of the duodenum was fixed in Zenker-formol, embedded in nitrocellulose, cut, and stained with hematoxylin-eosin-azure II. Autopsies were also done on untreated controls at intervals during the course of the experiment. As a preliminary test for the next experiment, 2 mice received a single dose of 600 r twenty-four hours after the last dose of 60 r per day for twenty days and autopsies were done twenty-four hours later (Group 4). Six mice died in the course of the irradiation and were not studied at autopsy.

Experiment A

60 r per day, 2 to 35 days	
No additional treatment	
Autopsy 3 hours after last irradiation.....	41 mice (Group 1)
Autopsy 24 hours after last irradiation.....	43 mice (Group 2)
Died during irradiation; no autopsies.....	6 mice
600 r additional in 1 dose	
Autopsy 24 hours later..	2 mice (Group 4)
Untreated controls.....	8 mice (Group 3)

Experiment B: The next tests, to determine the amount of radiation against which any acquired radioresistance would be effective, and its duration, were conducted simultaneously. A series of 138 mice of the same strain, sex, and weight as those used before, again after a preliminary period of four weeks in the laboratory, were divided into several groups. Eighty-four mice were exposed to 60 r per day for sixteen days under conditions identical with those in the earlier experiment. In 8 of these animals autopsy was done without further treatment (Group 5). Five mice (Group 6) were exposed to 1,200 r twenty-four hours after the last daily dosage (Fig. 1). Five to ten mice were exposed to either 600 r (Group 7) or 200 r (Group 8) after

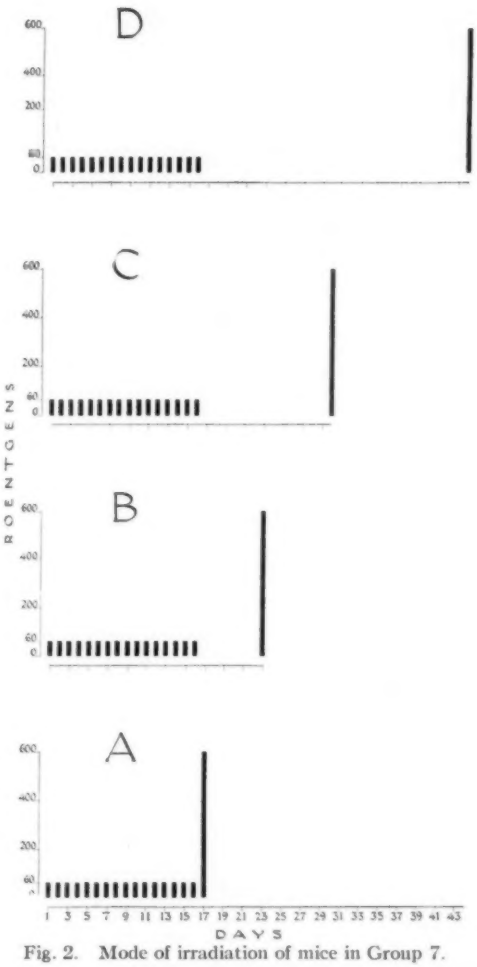


Fig. 2. Mode of irradiation of mice in Group 7.

intervals of twenty-four hours, one, two, or four weeks (Figs. 2 and 3). Other previously untreated mice received a single dosage of 1,200 r (Group 9), 600 r (Group 10), or 200 r (Group 11) at the same time as those which had been irradiated repeatedly. The single large doses were all given at the rate of 40 to 44 r per minute, except on one day, when the 600 r dosage was administered at the rate of 65 r per minute. Autopsies were performed on all animals three hours after the last exposure to irradiation. Eight untreated controls were also studied at autopsy (Group 12). Sections were prepared as described above.

Experiment B

(All autopsies three hours after last exposure)

60 r per day, 16 days	
No additional treatment.	8 mice (Group 5)*
Died during irradiation; no autopsies	7 mice
1,200 r additional in one dose	5 mice (Group 6)
600 r additional in 1 dose.	35 mice (Group 7)
200 r additional in one dose	29 mice (Group 8)
No daily dosage	
1,200 r in one dose	5 mice (Group 9)
600 r in one dose	21 mice (Group 10)
200 r in one dose	20 mice (Group 11)
Untreated controls	8 mice (Group 12)

* Two of this group were sacrificed four weeks later.

When the study was begun, some actual counts of degenerating cells and mitoses in representative fields were made, but this method, while less subjective in some respects than histologic description, proved unsatisfactory for comparing the duodenal sections. The distribution of cellular debris was found to be extremely irregular; it was sometimes concentrated in a few crypts in large amounts, sometimes scattered through many of them, so that the total count might be the same, whereas the damage qualitatively was altogether different. Therefore, the nature and extent of injury have been divided into the following categories: damage in most crypts, in many, in some, or in a few. Rough estimates of the amount of debris per crypt are expressed in values from 1+ to 6+. Exceedingly mild damage is called

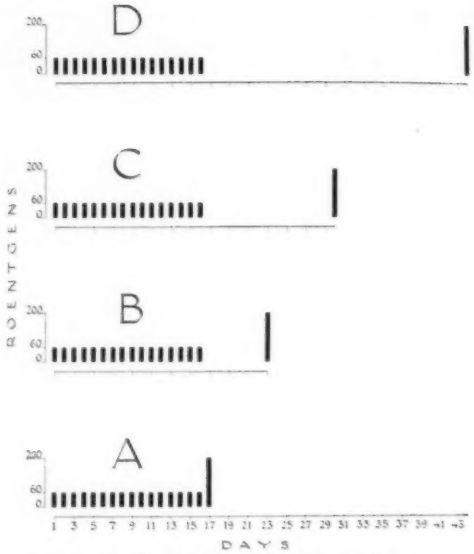


Fig. 3. Mode of irradiation of mice in Group 8.

1+, a moderate amount of debris, 3+, and debris in practically all cells, 6+. To a lesser extent this is also true of mitotic figures. The ideal method would have been to count all cells and tabulate the occurrence of mitoses and debris per crypt and per section. This would be an enormous task, and it is questionable whether it would furnish more pertinent data than the histologic estimate.

RESULTS

Experiment A: Daily Dosage of 60 r, Two to Thirty-five Days.

Untreated Controls: In all the untreated control mice of this series there were many mitoses in the epithelial cells of most of the crypts of Lieberkühn, although an occasional crypt had few or none. Rarely was there a bit of debris, and even more rarely a crypt with debris of more than a few cells (Table II).

Three-Hour Interval Between Irradiation and Autopsy: Three hours after the second of two daily dosages of 60 r many of the crypts contained debris. The degree of damage was mild in most of these, although the distribution of damage varied widely from crypt to crypt, with little in some and

TABLE 1: RELATIVE AMOUNTS OF DEBRIS AND FREQUENCY OF MITOSIS IN INTESTINAL CRYPT EPITHELIUM AFTER DAILY DOSES OF 60 r ROENTGEN IRRADIATION (TOTAL-BODY EXPOSURE)

Number of Daily Exposures	3 Hours After Last Irradiation (Group 1)					24 Hours After Last Irradiation (Group 2)		
	Debris in				Mitoses	Debris in		Mitoses
	Most crypts	Many crypts	Some crypts	A few crypts		Some crypts	A few crypts	
2			++		+++	+		++
		++			+++	+		++
3	+				+++		Trace	+++
	+				+++		Trace	+
4		++			+++	+		+++
		++			+		Trace	+++
5		++			+++		Trace	+++
		+			+++		Trace	++
6		+++			+++	+		+++
		++			+++		0	+++
7	++		+++		+++		+	+++
	++		+++		+++		+	+++
8	+++				++		Trace	+++
	+++				++		Trace	+++
9	+++				+++		+	+++
	+++				++		Trace	+++
10				Trace	+++		Trace	+++
				Trace	+++		Trace	+++
11	+				++		Trace	+++
	+				++		Trace	++
13				Trace	+++		Trace	++++
				+	+		++	+++
15				++	++		+	++
				+	+++		Trace	++
17				+	++		+	++
				++	++		Trace	++
				++	++		Trace	++
			++		++		+	++
20				Trace	+++		Trace	+++
				+	++		Trace	++
				+	++		Trace	+++
24				Trace	++		Trace	+++
				++	+		Trace	++
							++	+++
							Trace	+++
30				+	++++		Trace	++
				Trace	++		Trace	+++
				Trace	++		Trace	++
				Trace	+++		Trace	++
35				+	+++		0	+++
				+	+++		0	+++
				Trace	++		Trace	+++
			+	++	+++		0	+++

a moderate amount in others. Mitoses were absent from some crypts, numerous in others, sometimes in the same ones in which the cells were degenerating. Three to five daily exposures produced about the same radiation effects as two, both qualitatively

TABLE II: RELATIVE AMOUNTS OF DEBRIS AND FREQUENCY OF MITOSIS IN INTESTINAL CRYPT EPITHELIUM OF UNTREATED CONTROLS (Group 4)

Debris in				Mitoses
Most crypts	Many crypts	Some crypts	A few crypts	
			Trace	+++
			0	+++
			Trace	++++
			Trace	+++
			0	+++
			0	+++
			0	++++
			0	+++

and quantitatively. The damage varied from mild to moderate, and mitotic activity was as great as before.

The height of destruction of the crypt cells occurred during the period from six through nine exposures (Table I). The three-hour specimens after each of these showed moderate damage to most of the crypts, although even where debris was most heavily concentrated, normal-appearing epithelial cells predominated over degenerating ones. Mitotic activity showed no significant diminution.

From this time on, radiation effects fell off abruptly. After ten treatments only a trace of debris was present, and this was true also of about one-third of the later specimens, even after as many as thirty dosages (1,800 r). In the others the damage was generally very mild in degree. Mitoses were prominent throughout the series.

Twenty-Four-Hour Interval Between Irradiation and Autopsy: In contrast to the changes in sensitivity of the basal crypt cells examined three hours after repeated irradiation, when the mice were autopsied twenty-four hours after treatment these cells showed essentially no changes from normal. A trace of debris in an occasional crypt was usually noted, but no more than was present in some untreated controls. In less than one-third of the specimens was there more than this negligible amount of debris, and in these the damage was slight and usually confined to a few crypts. No increase in debris occurred even during the period when the height of destruction was seen in the three-hour specimens, and mitoses remained constant throughout.

From these observations it seems evident that, although the epithelium at the base of the duodenal crypts is sensitive to x-rays, it recovers quickly (within twenty-four hours) and, more important, after continued treatment it develops a definite radioresistance (Table I). This substantiates Pierce's observations on mice exposed to 80 r per day.

Experiment B: Single Large Dosage of X-rays Following Repeated Small Dosages.

Daily Dosage Controls: On the basis of the data obtained in the first series of mice, it was concluded that the three-hour interval was a more sensitive index than the twenty-four-hour interval (as the damage was repaired by the latter time) and that a period of 16 days with daily exposures to 60 r was sufficient to produce an increased radioresistance in the crypt cells. Actually, the mice of the second series which received only the daily dosage still showed mild damage to some of the crypt cells (Table III), although the number of

TABLE III: RELATIVE AMOUNTS OF DEBRIS IN INTESTINAL CRYPT EPITHELIUM OF CONTROLS

Number of Daily Exposures	Interval Between Last Irradiation and Autopsy	Daily Dosage Only (Group 5)				Untreated (Group 12)			
		Debris in				Debris in			
		Most crypts	Many crypts	Some crypts	A few crypts	Most crypts	Many crypts	Some crypts	A few crypts
16	3 hours			++	+++				0
				++	+++				Trace
				++	+++				Trace
					+				+
				++					0
			+++		++++				0
	4 weeks				0				0
					0				0

TABLE IV: RELATIVE AMOUNTS OF DEBRIS IN INTESTINAL CRYPT EPITHELIUM FOLLOWING 1,200 r AND FOLLOWING 16 DAILY DOSES OF 60 r AND A SINGLE DOSE OF 1,200 r GIVEN 24 HOURS LATER. ALL AUTOPSIES THREE HOURS AFTER FINAL IRRADIATION

Interval Between Daily Dosage and 1,200 r	Daily Dosage + 1,200 r (Group 6)				1,200 r Only (Group 9)			
	Debris in				Debris in			
	Most crypts	Many crypts	Some crypts	A few crypts	Most crypts	Many crypts	Some crypts	A few crypts
24 hours	+++++ +++++ +++++ +++++ +++++				++++++ ++++++ +++++ ++++++ +++++			

TABLE V: RELATIVE AMOUNTS OF DEBRIS IN INTESTINAL CRYPT EPITHELIUM FOLLOWING 600 r AND FOLLOWING 16 DAILY DOSES OF 60 r AND A SINGLE DOSE OF 600 r AT VARYING INTERVALS THEREAFTER. ALL AUTOPSIES THREE HOURS AFTER FINAL IRRADIATION

Interval Between Daily Dosage and 600 r	Daily Dosage + 600 r (Group 7)				600 r Only (Group 10)			
	Debris in				Debris in			
	Most crypts	Many crypts	Some crypts	A few crypts	Most crypts	Many crypts	Some crypts	A few crypts
24 hours	+++++ +++++ +++++ +++++ +++++ +++++	+++ ++++ +++++			+++++ +++++ +++++ +++++	+++++		
1 week	+++++ +++++ +++++ +++++ +++++ +++++	+++++ ++++			+++++ +++++ +++++ +++++ +++++			
2 weeks	+++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++	+++++			+++++ +++++ +++++ +++++ +++++			
4 weeks	+++++ +++++ +++++ +++++ +++++	+++++ +++	+++		+++++ +++++	+++ +++ ++++ +++		

mitoses was as great as in untreated controls (Table VII). In one specimen only was there as much debris as was seen during the six- to nine-day period of the earlier experiment. Thus, this group of daily irradiated mice, which served as controls for those pretreated and were then given one large dose of x-rays, manifested definite but not complete radioresistance after sixteen daily exposures to 60 r.

TABLE VI: RELATIVE AMOUNTS OF DEBRIS IN INTESTINAL CRYPT EPITHELIUM FOLLOWING 200 r AND FOLLOWING 16 DAILY DOSES OF 60 r AND A SINGLE DOSE OF 200 r AT VARYING INTERVALS THEREAFTER. ALL AUTOPSIES THREE HOURS AFTER FINAL IRRADIATION

Interval Between Daily Dosage and 200 r	Daily Dosage + 200 r (Group 8)				200 r Only (Group 11)			
	Debris in				Debris in			
	Most crypts	Many crypts	Some crypts	A few crypts	Most crypts	Many crypts	Some crypts	A few crypts
24 hours	+++++ +++++	+++ +++ +++++ +++ +++++ +++ +++	++++			++ +++++ +++++	++ +++	
1 week	+++++ ++++ +++++	+++++ +++++ +++ +++ ++++			+++++ +++++	+++ +++++ ++++		
2 weeks	+++++ +++++ +++++ +++++	+++ +++			+++++ +++++ +++++ ++++ ++++			
4 weeks	+++++	+++++ +++ +++ +++++			+++++ +++++ +++++ +++++		++	

1,200 r: Whether the mice were previously untreated or whether they had been exposed to 60 r a day for sixteen days (Fig. 1), when a single dose of 1,200 r was administered and autopsy was done three hours later, the picture was identical: there was a tremendous amount of debris in the cells of all the crypts, and mitoses were absent (Tables IV and VII). It was impossible to separate the two groups histologically. In other words, insufficient radioresistance had been built up to withstand a dosage of this magnitude.

600 r: The same massive destruction resulted when 600 r instead of 1,200 r was given in a single dosage twenty-four hours after the last of the daily exposures (Fig. 2A) and autopsies were made three hours later. Here again, there was no significant difference between the mice which had received the daily exposures and those previously untreated (Tables V and VII). In both groups there was a great amount of debris in the epithelial cells, and mitoses were absent or exceedingly rare. Thus 600 r, as well as 1,200 r, overcame the radioresistance built up by the repeated daily dosage. When an interval of one, two, or four weeks was allowed to elapse between the end of the daily irradiation and the single large dosage (Fig. 2, B–D), the results were the same as when only twenty-four hours intervened. In another test (Group 4 of Experiment A) in 2 mice it was found that the debris in the crypt cells and inhibition of mitosis were as prominent twenty-four hours after final treatment as in those mice sacrificed three hours after treatment.

200 r: The picture was much less uniform when 200 r was administered than with the higher dosages (Table VI). In

TABLE VII: EFFECT ON THE MITOTIC ACTIVITY OF THE INTESTINAL CRYPT CELLS OF A SINGLE LARGE DOSE OF ROENTGEN IRRADIATION ALONE OR PRECEDED BY 60 r DAILY FOR 16 DAYS

Interval Between Last Daily Dose and Single Large Dose	60 r daily + 1,200 r (Group 6), Mitoses	1,200 r only (Group 9), Mitoses	60 r daily + 600 r (Group 7), Mitoses	600 r only (Group 10), Mitoses	60 r daily + 200 r (Group 8), Mitoses	200 r only (Group 11), Mitoses	Controls Untreated (Group 12), Mitoses
24 hours	0	Rare	Rare	0	+++	++	++++
	0	0	0	0	++	Rare	+++
	0	0	0	0	+++	+	+++
	0	0	0	Rare	+++	+	+++
	0	Rare	Rare	0	+++	+	++++
			Rare		++		+++
			0		+++		++++
			Rare		+++		+++
			0		++		
			Rare		+		
							60 r daily only (Group 5) Mitoses
1 week			0	0	+	+	
			0	0	++	Rare	
			0	0	++	Rare	
			0	0	+	+	
			0	0	++	0	
			Rare		++		++++
			0		++		++++
			0		+		++++
							+++
							++++
							+++
2 weeks			0	0	Rare	+	++++*
			0	0	Rare	+	+++*
			0	0	Rare	Rare	
			0	0	Rare	Rare	
			0	0	+	+	
			0		++		
			0				
			0				
			0				
4 weeks			0	0	++	+	
			0	0	++	Rare	
			0	0	++	++	
			Rare	0	+	+++	
			0	0	+++	++	
			0	0			
			0				
			0				

* Autopsy 4 weeks after final irradiation.

previously untreated mice 200 r produced less severe damage to the crypt cells than 600 r. In a number of specimens fewer crypts were damaged than after 600 r and the debris per crypt was considerably less, whereas in others there was as much debris as after the higher dosage. Mitotic activity varied even more than the amount of debris. In contrast to its inhibition after 600 r, after 200 r mitosis was usually present, though generally less pronounced than in untreated controls.

With an interval of one or seven days between the daily dosage of 60 r and the dosage of 200 r (Fig. 3, A and B), mitoses were markedly increased in the crypts over those from mice exposed to 200 r without previous irradiation (Table VII). Destruction of cells, however, as indicated by the presence of debris, differed little in these groups from that in the previously untreated animals (Table VI). In many specimens there was much debris in most of the crypts; in others, it was only moderate in amount, and many crypts were undamaged. When the interval between the last of the daily dosages and the single large dosage was only one day, the number of mitoses was frequently as large as in untreated controls. When the interim was greater, mitoses were fewer, although with an interval of one week they still exceeded

those after 200 r in animals not pretreated.

With longer intervals between pretreatment and the single dosage, the resistance built up by the daily exposures was no longer evident. After two weeks (Fig. 3C) mitoses were rare. After four weeks (Fig. 3D) they were more numerous than after two weeks, but they were no more frequent than in animals which received 200 r only at the same time. Thus, limited radioresistance was established by the repeated daily exposures, as indicated by the persistence of mitosis, only when the time interval before the single large dosage did not exceed one week.

DISCUSSION

There have been numerous examples of irradiated cells and organs showing increased resistance to further irradiation. This is a frequent observation in the clinical treatment of tumors and has been the subject of some experimentation. Regaud and Nogier (7) showed, by successive biopsies, that equal doses of x-rays administered in eleven exposures over a period of six months became less and less effective in the treatment of a myxosarcoma. Their explanation of this diminution of radiosensitivity is a self-immunization of the cells of the neoplasm against the effects of the rays, conditioned by humoral modifications caused by the resorption of the waste products of the necrobiotic cells. Russ (8), studying the growth of transplanted Jensen rat sarcoma, also demonstrated an acquired resistance to x-rays after repeated dosages. He found that the dosage necessary to prevent growth of tumor tissue when the latter was inoculated into normal susceptible animals was increased 2.5 times after repeated irradiations. Mottram (9), extending Russ' study, concluded that repeated sublethal exposures of tumor cells to either beta or gamma radiation raise their resistance to these radiations. Snellman (10) also observed a marked reduction in radiosensitivity of previously irradiated tumors. Sections from the more radioresistant tumors showed considerably fewer mitoses and more collagen substance than those from tumors not previously irradiated. Windholz (11) noted the destruction of some of the cells of the normal laryngeal epithelium by irradiation and the development of a new metaplastic epithelial structure, the cells of which were characterized by the ability to regenerate under dosages of irradiation which previously destroyed them. Thus the regenerated epithelium displayed signs of increased radioresistance.

Acquired radioresistance to roentgen irradiation has also been demonstrated in plant cells. Ancel and Lallemand (12) and Lallemand (13) exposed germinating lentils to single and multiple dosages of x-rays and observed a diminished sensitivity of the cells after an initial irradiation. In Lallemand's experiments, multiplication of the fractions did not augment the degree of protective effect.

In the present experiments, the epithelium of the intestinal crypts in the mouse, known to be extremely sensitive to irradiation, has been shown to become radioresistant after a preliminary period of sensitivity during the first days of repeated total-body exposure to 60 r of x-rays. When a definite increase in radioresistance was established, after ten daily exposures or more, with a total irradiation of 600 to 2,100 r, mitotic activity remained normal and degeneration of cells was absent or minimal. This agrees essentially with Pierce's findings on the mouse intestine after total-body irradiation with repeated exposures to 80 r per day (5).

In the experiments reported here, the degree of this acquired resistance to further roentgen irradiation was found to be limited. Against 200 r it was only partially effective. When the 200 r exposure was made twenty-four hours after the 60 r daily exposures ended, mitotic activity was not inhibited, but degenerating cells were as numerous as in animals exposed to 200 r without pretreatment. Even when seven days elapsed before exposure to the 200 r dosage, mitoses, although fewer than after the one-day interval, were more numerous than when there had been no preliminary irradiation. Two and four weeks after the

period of daily dosage, however, no evidence of acquired radioresistance remained. The preliminary irradiation failed completely to protect againt 600 or 1,200 r subsequently administered in one dose, even after as short an interval as twenty-four hours. The duration of acquired radioresistance might well be lengthened by varying such conditions of the experiment as dosage during pretreatment, intervals between doses in the pretreatment period, etc. For instance, Cronkite *et al.* (14), in a recent study of the mortality of mice subjected to a lethal dose of x-rays thirty days after the last of three sublethal doses, found the mortality to be 26 per cent, in contrast to 41 per cent in their unpretreated group. Apparently some radioresistance acquired by the pretreated group persisted during the thirty-day interval. Histologic studies of such mice would be interesting.

One factor which should be considered in comparing the effects of the daily dosage and the single large dosage is the intensity of the radiation. In the experiments reported here, the daily exposure to 60 r was given at the rate of 3 r per minute, whereas the single large doses were given at about 40 r per minute. It is well known that the effects of roentgen irradiation are more severe the higher the dosage rate. This has been demonstrated by a number of investigators. Holthusen (15), for example, obtained the same degree of erythema with 500 r delivered in one minute, 900 r in fifty minutes, and 1,400 r in about eight hours. Whatever the influence of the intensity factor, it does not affect the results *within* the repeated 60 r dosage group described here, where the rate was constant. Also, in comparing the radioresistance of the previously irradiated and non-irradiated mice to single large dosages of x-rays, the intensity factor may be disregarded, since the single doses were administered to both groups at the same rate. Nevertheless, it seems reasonable to assume that, had the single large doses been administered at a slower rate than 40 r per minute, the radioresistance would have been greater. It would be desirable to compare the radiosensitivities of the crypt cells using the same total exposure but varying the rate.

Another question that arises is whether there is a primary stimulation of mitosis in contrast to a secondary increase of mitosis in response to injury. As mitoses in our irradiated mice never exceeded those in untreated controls, there is no evidence in this material of a primary stimulation.

Because the number of animals that could be treated simultaneously under identical conditions was limited in the present study, observations were not made at as many intervals after irradiation as would have been desirable. Thus, in the first experiment, where we had some previous data to guide us and therefore usually performed autopsies on only 4 mice after each exposure, the intervals of three and twenty-four hours were selected somewhat arbitrarily. Then, having observed recovery by twenty-four hours, in the second experiment only the three-hour interval. We studied Knowlton, Hempelmann, and Hoffman (16) noted a marked depression in mitotic activity in the cells of mouse epidermis as early as one-half hour after exposure to 35 r, with a return to normal by five hours. One cannot extrapolate from their single 35 r exposure to 60 r which we gave daily, but their curve suggests the desirability of studying intervals between three and twenty-four hours, as well as some earlier than three hours. However, a test on only 2 mice, which had acquired radioresistance through daily 60 r exposures and were autopsied twenty-four hours instead of three hours after a subsequent dosage of 600 r, showed essentially the same histologic picture as the much larger three-hour group. It would seem from this that any acquired radioresistance is not only insufficient to prevent large-scale destruction of the cells and cessation of mitosis, as seen three hours after 600 r, but that it is also insufficient to permit recovery by twenty-four hours.

Correlation between injury to any particular group of cells or tissues and mortality after roentgen irradiation is outside the field of the present study. It may be

noteworthy, however, that the height of the damage to the crypt cells produced by 60 r per day exposures to x-rays slightly precedes in time a transient peak in the time curve of mortality obtained by Sacher (17) from similarly treated mice.

SUMMARY

1. Repeated total-body exposures of mice to 60 r roentgen radiation per day resulted in a lessened sensitivity of the crypt epithelium of the duodenum. Debris in these cells three hours after the last irradiation passed on successive days through a maximum and then diminished despite continued treatment. An attempt has been made to measure the degree of this acquired radioresistance in terms of decrease in debris and persistence of mitosis.

2. (*a*) The duodenal crypt cells showed mild damage after 60 r per day, reaching a peak in mice autopsied three hours after six to nine daily exposures. Recovery was complete in mice autopsied twenty-four hours after the final irradiation.

(*b*) With continued treatment (10 or more exposures) these cells became resistant to this daily dosage (as indicated by negligible amounts of debris and persistence of mitotic activity), even when the total dosage had accumulated to 2,100 r.

(*c*) Mitosis was not interrupted and was rarely diminished in this series of low-dosage repeated irradiations.

3. (*a*) This acquired radioresistance was not sufficient to prevent degeneration of the basal crypt cells or a cessation of mitosis when 600 or 1,200 r was given subsequently in a single dose.

(*b*) When the single dose following the daily exposures was 200 r, and an interval of only one day or one week intervened, there was partial protection against the 200 r exposure: the amount of debris was not diminished, but there were many more mitoses in the crypt cells of mice which had been previously irradiated than in those which had not.

(*c*) The enhanced radioresistance present at one day and one week was lost when the interval between the termination of the small daily dosages and the 200 r dosage was extended to two or four weeks.

ACKNOWLEDGMENT: The method of indicating graphically the exposure procedure used in the figures was suggested by Dr. R. E. Zirkle.

I am indebted to Mr. George Sacher for his help in the irradiation of the mice in these experiments.

P. O. Box 5207
Chicago 80, Ill.

REFERENCES

1. REGAUD, C., NOGIER, T., AND LACASSAGNE, A.: Sur les effets redoutables des irradiations étendues de l'abdomen. Arch. d'électric. med. **21:** 321, 1912.

2. WARREN, S. L., AND WHIPPLE, G. H.: Roentgen Ray Intoxication. Unit Dose Over Thorax Negative—Over Abdomen Lethal. Epithelium of Small Intestine Sensitive to X-Rays. J. Exper. Med. **35:** 187–203, 1922.

3. WARREN, S. L., AND WHIPPLE, G. H.: Roentgen Ray Intoxication. The Cumulative Effect or Summation of X-Ray Exposures Given at Varying Intervals. J. Exper. Med. **38:** 725–730, 1923.

4. FRIEDMAN, N. B., AND WARREN, S.: Evolution of Experimental Radiation Ulcers of the Intestine. Arch. Path. **33:** 326–333, 1942.

5. PIERCE, M.: The Gastrointestinal Tract. In Histopathology of Irradiation from External and Internal Sources, W. Bloom, Editor. NNES, Div. IV, Vol. 22I, 502 (1948), New York, McGraw-Hill.

6. SACHER, G. A.: Survival of Mice under Duration-of-Life Exposure to X-rays at Various Dose Rates. NNES, Div. IV, Vol. 22 C. To be published. New York, McGraw-Hill.

7. REGAUD, C., AND NOGIER, T.: Histoire clinique, histologique et radiologique d'un myxo-sarcome. J. de radiol. et d'électrol. **2:** 135, 1916.

8. RUSS, S.: Experimental Studies upon Lethal Doses of X-Rays and Radium for Human and Other Tumours. Brit. J. Radiol. **29:** 275–292, 1924.

9. MOTTRAM, J. C.: On the Relationship Between β and γ Radiation in the Treatment of Tumours. Brit. J. Radiol. **5:** 768–774, 1932.

10. SNELLMAN, B.: Attempt to Develop Reduced Radio-sensitivity in Jensen Rat Sarcoma by Means of Roentgen Irradiation. Acta radiol. **16:** 545–556, 1935.

11. WINDHOLZ, F.: Problems of Acquired Radioresistance of Cancer: Adaptation of Tumor Cells. Radiology **48:** 398–404, 1947.

12. ANCEL, P., AND LALLEMAND, S.: Sur la protection contre l'action des rayons X par une irradiation préalable (radiophylaxie). Compt. rend. Soc. d. biol. **99:** 1588–1590, 1928.

13. LALLEMAND, S.: Étude de l'action des rayons X sur le développement des plantes. Arch d'électric. med. **39:** 223, 271, 1931.

14. CRONKITE, E. P., SIPE, C. R., ELTZHOLTZ, D. C., CHAPMAN, W. H., AND CHAMBERS, F. W., JR.: The Increased Tolerance of Mice to a Lethal Dose of X-Ray Radiation as a Result of Previous Sublethal Exposures. Naval Medical Research Institute, National Naval Medical Center, Bethesda, Maryland, Project NM 007 039, Report No. 15, August 17, 1948.

15. HOLTHUSEN, H.: Vergleichende Untersuchungen über die Wirkung von Röntgen- und Radiumstrahlen. Strahlentherapie **46:** 273–288, 1933.

16. KNOWLTON, N. P., JR., HEMPELMANN, L. H., AND HOFFMAN, J. G.: Effects of X-Rays on the Mitotic Activity of Mouse Epidermis. Science **107:** 625–626, 1948.

17. SACHER, G. A.: Personal communication.

SUMARIO

Radiorresistencia Adquirida del Epitelio Folicular del Duodeno

1. Las repetidas exposiciones de todo el cuerpo de los ratones a 60 r de radiación roentgen diariamente hizo disminuir la sensibilidad del epitelio de las criptas del duodeno. Los desechos en las células afectadas a las tres horas de la última irradiación pasaron, en días sucesivos, por un máximo, para descender luego a pesar del continuo tratamiento. Tratóse de medir la intensidad de dicha radiorresistencia adquirida en términos de disminución de los desechos y persistencia de la carioquinesis.

2. (a) Las células de los folículos duodenales revelaron leves lesiones después de recibir 60 r al día, alcanzando su acmé las últimas en los ratones autopsiados tras seis a nueve exposiciones diarias. La reposición era completa en los ratones autopsiados a las veinticuatro horas de la irradiación final.

(b) Con el tratamiento continuo (10 ó más exposiciones), dichas células se volvieron resistentes a la dosis diaria mencionada (según indicaban las menospreciables cantidades de desechos y la persistencia de la actividad carioquinética), aun cuando la dosis total acumulada era de 2,100 r.

(c) No se interrumpió la carioquinesis y rara vez disminuyó en esta serie de irradiaciones repetidas a baja dosis.

3. (a) Dicha radiorresistencia adquirida no fué suficiente para impedir la degeneración de las células basales de las criptas o el cese de la carioquinesis cuando se administraban subsiguientemente 600 a 1,200 r en una sola dosis.

(b) Cuando la dosis única consecutiva a las exposiciones diarias era de 200 r, y sólo intervenía un plazo de un día o una semana, había protección parcial contra la exposición a 200 r: no disminuyó la cantidad de desechos, pero había mucha más carioquinesis en las células foliculares de los ratones previamente irradiados que en los que no lo habían sido.

(c) La radiorresistencia realzada presente al día y a la semana se perdía cuando se extendía a dos a cuatro semanas el intervalo entre la terminación de las pequeñas dosis diarias y la dosis de 200 r.

Concerning the Radiologist and the Future[1]

EUGENE P. PENDERGRASS, M.D.

Philadelphia, Penna.

ONE OF THE duties of your President is to address the Annual Conference of Teachers of Clinical Radiology. Immediately upon notification of this task, I began to become concerned as to what I should attempt to say. In my search for an idea, I was reminded of the message on a placard alleged to have been posted on the mantel in the home of Irving Bacheller. It is this:

"DEAR MR. BURGLAR: Please excuse this barren waste. The truth is, others in your line got here first. The money is mostly in their possession. You will find the family jewels in a pill box on the parlor mantel. The only other thing here worth having is my opinion of these evil days. If you care for that come and wake me. There is an unfinished novel on the desk in the study. Please don't start to read it, as the last month's electric light bill is not yet paid and the cook objects to have guests at breakfast. If, after looking the ground over, you wish to leave some money for the children for Christmas, please put it in the green vase on the parlor table."

I am in very much the same dilemma as the thief who was told that others had been there before him. Many eminent speakers have preceded me. Like every speaker today, I can find a mechanism to allow me to state that the world is undergoing rapid changes, as though you were not aware of the fact, and as though the world were not constantly changing, albeit more rapidly at one time than another. All of these changes have been and are irresistible, and the best you and I can do is to attempt to direct to as good purposes as possible what is new, using what has been learned from the old. It is certain, too, that the present time is one of extremes. But have we not always had extremes, and will we not until the Utopian age when all of us will be calm and intelligent? It is, after all, only the occasional philosopher who can quietly search for middle ground and adopt it. History demonstrates that most of us proceed to and by extremes and only slowly reach a middle ground, which, having attained, we retain but temporarily, soon to be off again on a rampage of extremes.

You and I can be proud of some of the things that the American College of Radiology has accomplished and is attempting to do; for instance, the self-examination of the morning program: "Deficiencies in Resident Training as Revealed to the Practising Radiologist," and the exploratory program of the afternoon entitled: "Conference on Radiology in Rural Health." Such programs have to do with "setting our sights" for the future.

The medical profession has been accorded certain privileges by society. The specialty of radiology has been accorded certain privileges by the profession at large. By having pioneered a new field of enormous scope and value, radiology has assumed a position of leadership for itself, and the profession at large now looks to the specialty as a select group possessing authority in certain aspects of the science and art of medicine.

With these privileges, there is a corollary responsibility, which we as radiologists owe to the profession and to society. With the privileges and the authority we possess, we have a responsibility to advance as rapidly as possible the contributions which this field of medical knowledge can offer in diagnosis and treatment of disease.

Each generation of radiologists receives, as it were, a torch from the generation which preceded it. With the inspiration which the teachers of clinical radiology are expected to give their disciples, it is their

[1] An address presented before the Annual Conference of Teachers of Clinical Radiology, American College of Radiology, February 1949. Published in part in the *Monthly News Letter* of the American College of Radiology, December 1949.

responsibility to carry this torch forward and make it burn ever more brightly.

In order to accomplish any such mission, it is necessary for each of us to provide for ourselves a rigid and courageous discipline. The Greeks said: "Know yourself"; the Romans, "Be yourself"; the Christians, "Give yourself." Our efforts should be to fuse these three swords into a great instrumentality. Today I would like to direct your attention to the third discipline—"Give yourself." If this discipline were organized and arranged in the form of a book, it might well contain an introduction and six chapters.

The *Introduction* would be written by someone, who, like Osler, loved medicine. The theme might well be that used by Osler on several occasions—and in particular the address that he gave to the undergraduates at the University of Toronto in 1903, entitled "The Master-word in Medicine." Some of his remarks may be quoted, as follows:

"Though a little one, the master-word looms large in meaning. It is the open sesame to every portal, the great equalizer in the world, the true philosopher's stone, which transmutes all the base metal of humanity into gold. The stupid man among you it will make bright, the bright man brilliant, and the brilliant student steady. With the magic word in your heart all things are possible, and without it all study is vanity and vexation. The miracles of life are with it; the blind see by touch, the deaf hear with eyes, the dumb speak with fingers. To the youth it brings hope, to the middle-aged confidence, to the aged repose. . . . It is directly responsible for all advances in medicine during the past twenty-five centuries. . . . With its inspiration Harvey gave an impulse to a larger circulation. . .an impulse which we feel today. . . . With it Virchow smote the rock. . .while in the hands of Pasteur it proved a very talisman to open to us a new heaven in medicine and a new earth in surgery. Not only has it been the touchstone of progress, but it is the measure of success in every-day life. . . . And the master-word is *Work*, a little one, as I have said, but fraught with momentous sequences if you can but write it on the tablets of your hearts, and bind it upon your foreheads."

Chapter I would be entitled *Keep Informed*. The importance of keeping ourselves informed is emphasized by Dr. Thomas G. Orr, who states:

"Any professional man is hardly doing his full duty to himself and to the profession he represents unless he gives some time to education and cultural improvement. . . . A doctor cannot afford to be substandard in things educational or the evidence will crop out somewhere and his shortcomings be made evident. Education keeps us out of a rut, it demands respect, and, of equal importance, it is a lasting pleasure."

The title of Chapter II might read: *Be Concerned About Present Trends*. We could do no better than follow the admonition of President Glenn Frank of the University of Wisconsin, who said:

"The great doctor must know almost as much about the social order as the sociologist. This is necessary because the varied forces—political, social, economic, industrial, educational, religious—that march across a nation, making its mind or marring its spirit, register their effects in the lives of the doctor's patients. The more the doctor knows about these forces that make the atmosphere in which men's minds and bodies live, the more intelligently can he trace effects to their causes, and the more wisely can he counsel his patients."

Chapter III would carry the heading: *Be Not Too Casual About Our Political Freedom*. I think you will agree that doctors as a group have been too casual in this respect. Most of us are asleep at the switch. Men have made a bad mess of world affairs. We seem to have forgotten that one cannot train a tree that is two feet in diameter. If it has a bend in it, that bend is going to stay. Few things happen by chance. The meandering stream, apparently so casual and capricious, is obeying the laws of gravity and physics. Animals live largely by instinct, by the habits of countless generations of ancestors. We are to a large degree set free from control by instinct, but we are not yet wise or interested enough to use our intelligence fully. This is no time to be blinded with enthusiasm and tread the flowery paths of optimism, or to forget the admonition of Plato, who said that if a man scornfully refuse his call to govern, it will be his fate to be ruled by a worse one.

Chapter IV would concern *Public Relations*. It is generally agreed that the medical profession should provide the

public with such information as will assist them in their understanding of the nature, purpose, and results of the efforts made by scientific medicine in the prevention, control, and cure of disease. I am inclined to agree with Dr. W. D. Chapman who says: "A better-educated public assuredly demands a better-behaved profession." This afternoon we are meeting in a Conference on Radiology in Rural Health, to fulfill one of the obligations we, as a profession, owe to the public—the obligation to see that good radiological service is extended to as many people as possible under our social and economic system.

Chapter V would be entitled *Attend Medical Meetings*. Dr. J. N. Hall has said:

> "The physician who does not associate with his fellows runs great risk of falling into one of two errors. Either he becomes an egotist because he fails to see the good work that others are doing or, if of a timid nature, and faithful in his work, from knowing his own weaknesses so well, he feels that he is immeasurably behind his brothers in the profession."

Trees have commerce with the sky during summer and winter. If they are cut off they die. So it is with us. If we believe in medicine and, in particular, in radiology, we should share our belief with others.

Chapter VI, the final chapter, would bid us *Do The Best That We Know How*. Our freedom of practice is challenged today as never before. Freedom, as many have pointed out, is not a gift from heaven. It must be won and rewon by every generation for itself. This is an individual and collective task. If we are to remain free, it will be necessary for us to work as though the whole struggle depended alone on the efforts of each one.

I have attempted to present a pattern of self-discipline for your consideration. It is an old story but one which is still applicable. It is my hope that as we gather around this and other tables in the future we can truly say:

"I have loved no darkness,
Sophisticated no truth,
Nursed no delusion.
Allowed no fear."[2]

3400 Spruce St.
Philadelphia 4, Penna.

[2] Quoted by Osler in his address "L'Envoi," May 2, 1905.

SUMARIO

El Radiólogo y el Porvenir

Considerando al radiólogo en relación con el porvenir de su especialidad, bosquéjase un plan de autodisciplina, que se expone bajo seis encabezados y una Introducción, en la forma siguiente:

Introducción: Trabajo, la palabra mágica.

I. Hay que mantenerse informado.
II. Hay que interesarse en el movimiento de ideas (políticas, sociales, industriales, educativas, religiosas).
III. No hay que mostrarse demasiado indiferente a nuestra libertad política.
IV. No olvidar las relaciones con el público.
V. Hay que asistir a las reuniones médicas.
VI. Hágase siempre lo mejor que se pueda.

Lo anterior fué presentado en un discurso ante la Conferencia Anual de Profesores de Clínica Radiológica, en febrero, 1949.

EDITORIAL

New Developments in the Cancer Field[1]

It is very fortunate to have this opportunity to talk with you about the problems that we face in the control of cancer—the steps that have been taken, the steps that still are to be taken in obtaining a final answer. You, as radiologists, are as important a link as any in the chain of cancer control. From the diagnostic standpoint, your work is of tremendous importance. From the therapeutic standpoint, your contributions are great, and a large share of the hope of future advances lies in your field.

What I have to tell you will be culled not from my own experience but from that of the great body of workers going back to the days of Roentgen and Curie, on the one hand, and reaching up to the pioneers of the present day such as Ernest Lawrence.

As regards the etiology of cancer, there are several important things that have been fully appreciated only recently. One of the first is its universality. When I was in medical school I was taught, as I believe many of you were, that cancer was a disease of man and a disease closely related to civilization. We know now that it is a disease of virtually every type of vertebrate, that there are cancers in frogs, goldfish, and chickens. The most serious threat to the poultry industry is the leukemia that occurs in chickens. There is no type of animal that is immune to cancer. There is, so far as we have been able to determine, no race or group of men that is not susceptible to the disease.

Hints have been gathered in decades of study that will serve as guideposts in future research bearing on etiology. First, it is obvious that there is no one etiological factor. You are familiar with the production of skin cancer by repeated exposure to small doses of radiation. You are familiar with the heightened incidence of leukemia among radiologists owing to the subjection of the bone marrow to repeated irradiation. You are familiar with the fact that some industries, as for example the aniline dye industry, have had a greater incidence of cancer than they normally would be entitled to. In fact, the oldest knowledge we have of an occupational disease is related to the etiology of cancer. Percival Pott, in 1775, observed a high incidence of cancer of the scrotum in London chimney sweeps, an observation culminating in the brilliant work of Cook and Kennaway in 1930, showing that certain of the carcinogenic hydrocarbons in coal tar were the effective agents. Today we have been able to carry chemical carcinogenesis a step further. There are now over 900 compounds which can be used to produce cancer in the experimental animal. Some of these have been successfully tagged with radioactive carbon so that it will be possible to follow in detail their course and metabolism in the animal body.

We have learned, so far as the etiology of cancer is concerned, that whatever the inciting cause may be, it has to act for a long time in most instances. This accounts for the increased incidence of cancer in the older groups.

We have also learned, thanks to the experiments of Berenblum and his colleagues, along with those of Rous and his coworkers, that if one applies two carcinogenic stimuli, they are additive, that the cancer will appear sooner. In fact, nonspecific inflammatory stimulus to a tissue is sufficient to increase the number of can-

[1] Presented at the opening session of the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 5, 1949.

cers produced and to shorten the time in which they will be produced by carcinogenic substances.

There is much evidence that some specific change occurs in the body when cancer once develops there. While cancer is a disease of cells and a disease which is transmitted in most mammals by direct transplantation of cells, nonetheless there are general changes in the body that have to be weighed. It is possible to produce a sort of immunity in the experimental animal. If, for example, one takes a transplantable tumor in the mouse, plants that tumor in the tail of the animal and then amputates the tail after the tumor has grown for a week or so, that mouse can no longer be the host of a similar tumor.

This general change in the body, first demonstrated in the human subject by my colleague, Dr. Olive Gates, in her studies of multiple malignancy, is of very great importance, because it has pointed out to us that a patient once cured of cancer is not, as in the case of a patient who has had measles or whooping cough, henceforth immune to the disease, but rather has continued susceptibility; the person who has once had a cancer has a much greater chance of having new cancers than one in the general population.

This concept that there is something happening in the body as a whole when cancer develops has importance from the standpoint of diagnosis. We do not yet have a satisfactory test comparable with the Wassermann test or Kahn test in the case of syphilis, for the diagnosis of cancer, but we have a number of indications that there is something that can be detected. Thus a variety of tests, including that of Huggins, the one most recently developed, indicate that in some 80 per cent of people with cancer there has occurred a subtle change in the proteins of the blood. There are tests such as the Bolen test, showing a curious change in the pattern of a drop of blood as it dries. No one of these tests is as yet sufficiently accurate for clinical use, but the very fact that they work to some extent is an indication that something tangible has happened in the body. We are probably not too far away from some reasonably satisfactory type of diagnostic procedure.

Perhaps at this point it would be well to bring out one of the statistical fallacies encountered in appraising these tests, which also applies to the screening process by the Papanicolaou technic: the great bulk of the population does not have cancer at any one time, so if one ran through any test and called every case negative, it would mean that one would obtain over 90 per cent accuracy. For all practical purposes, unless a test is around 95 per cent accurate it is not valuable for routine diagnosis.

One important technic of the radiologist is only beginning to be appreciated in full, and requires more technical advance before it can be fully exploited. That is the use of radiography for mass screening purposes, most highly developed for the diagnosis of tuberculosis, but offering as a useful by-product the detection of cancer of the lung. If one takes those cases in which there has been a positive finding roentgenologically in the lung and then eliminates those in which the sputum is positive for tuberculosis and gives them appropriate care, one has a residuum that probably includes the majority of the cancers of the lung in the screened population.

The Papanicolaou technic is applicable to any of the body secretions or excretions. It was developed first, you will recall, for diagnosis of the cells cast off from the female genital tract in the vaginal secretion. The underlying principle of the Papanicolaou test is two-fold. *First*, cancer cells can be distinguished with a high degree of accuracy even when they occur singly. Dr. Papanicolaou has shown us how that can be done by determining the shape and size of cells, the shape and character of the nucleus, the relationship of the nucleus to the cytoplasm. *Second*, the cells of a cancer do not adhere closely together, so that there is a much greater loss of cells from a cancer than there is from normal tissue. There may be more cells lost from a cancer not over a centimeter in

diameter in the cervix of the uterus than from all the rest of the female genital tract put together. Thus, we have a much better chance of picking up the tumor cells because of the high rate at which they are shed and because of their distinctive characteristics.

This Papanicolaou technic is applicable to a number of secretions. The appraisal that Dr. Gates and I are using in our current work is shown in the accompanying table.

APPRAISAL OF DIAGNOSTIC VALUE OF SMEARS OF FLUID FROM VARIOUS SOURCES

	Vaginal Fluid	Urine	Sputum	Gastric Washings
Adjunct to biopsy	+	+	+	+
Mass screening	±	±	+	0
Obscure cases	+++	++	+++	+
Recurrence	+++	+++	+++	+
Radiation reaction *vs.* tumor	+++	++	0	0

From the standpoint of therapy, perhaps the most significant trend that we have seen in recent years is the advent of chemotherapy of different types. The first real break in this problem came with the demonstration by Dr. Huggins that the use of female sex hormone and estrogenic materials was effective in the therapy of cancer of the prostate, not permanently but from the palliative standpoint. The field has now been extended to cancer of the breast.

Then there has developed the field of various enzyme-inhibiting substances, analogues of one type or another, such as the folic acid antagonists in leukemia and others which are effective in inhibiting for a period of time the growth of various types of cells.

There are specific substances which injure protein, particularly nucleoprotein—nitrogen mustards and the substances related to them.

There are obtained from some bacteria substances which induce regression in tumors. Many of you will remember Coley's toxins, the first indication there might be something effective. The work of Shear and his colleagues at the National Cancer Institute and elsewhere has carried this on much further and developed new fields in relation to it. There are a considerable variety of bacterial products which in the experimental animal and sometimes in the human will induce transient, although not permanent, regressions.

It is in the field of enzymic inhibitors perhaps that a great hope for the future in the control of cancer lies. It is of interest that the enzyme systems are highly specific and that one can develop inhibitors that are almost equally specific, some of them protein in nature, some fairly simple in character. For example, if we take a tissue such as the brain, that has a relatively simple metabolism, using carbohydrate almost entirely, we find that with insulin we can inhibit one type of action in the carbohydrate cycle. We can with sodium azide interfere with another, and with chronic poisoning with cyanide with still another. It is possible that with further refinement of our knowledge of these enzyme inhibitors we may be able to get one or a group that will be able specifically to prevent successful continued life of tumor cells, while permitting normal cells to go about their way. This is perhaps too much a dream, but in the light of what has been accomplished so far it is at least worth very careful exploration.

So far as radiation therapy is concerned, there are several open avenues ahead. The advances of the physicists have opened up to you a range of energies that previously would have been inconceivable. I can remember very well talking with Dr. Holmes and Dr. Duane twenty odd years ago and hearing them say: "If we could only get a million-volt x-ray machine, just think what could be accomplished!" Now, with the synchrotron, seventy million volts are within your reach; there are almost no limits to the types of energy which you can apply.

We have greatly advanced our knowledge of the relative biological effectiveness of the different types of radiation. We have learned that a given reading on the Victoreen, a given reading on the Geiger-

Müller counter, a given reading of the film badge, does not of necessity mean the same biological effect. We have learned to compare the biological effects of some of the radiations that are now available. If, for example, one takes as a standard 1 roentgen as produced by the familiar 200-kv. x-ray, we have a biologic effectiveness for the gamma rays of radium of 1, for beta rays, as those of phosphorus^{32}, again a value of 1; in the case of the neutrons produced by the chain-reacting pile or the cyclotron, a biologic effectiveness of 10; in the case of alpha particles, poorly penetrating but with a dense ionization path, a factor of 20 times the conventional x-ray.

Also, in the past our field of irradiation was largely limited to the external surface of the body and such internal aspects as could be readily reached either by cone or radium applicator. With the development of radioactive isotopes, the possibility of effective selective internal radiation has become possible. If, for example, we wanted to treat a cancer of the thyroid in the past, we had to depend first on the x-ray to tell us where there might have been metastasis, and second, on surgery plus x-ray for therapy. In those types of cancer of the thyroid that pick up radioactive iodine (not all of them do, unfortunately), we can administer orally or intravenously radioactive iodine, and the selective uptake by the thyroid cancer cells is such that there will be an effective concentration of the radioactivity right in the cells we want to hit. We do not have to hunt for the metastases. The radioactive iodine hunts them out for itself. This is not true of all types of thyroid cancer, but of enough to make it helpful and effective.

In treatment with radioactive phosphorus, there is a selective uptake by leukemic cells, in bone marrow, in the liver, in the kidney, wherever they happen to be. A further advantage in treatment with radioactive isotopes is that radiation sickness, sometimes a troublesome complication of radiation therapy, is totally avoided.

The longest experience in the therapy of leukemia with P^{32} is that of Dr. John Lawrence of Berkeley. In his recent articles in the *Journal of the American Medical Association* he pointed out that one-third of his leukemia patients are living free from disease for five years. In the light of the newness of treatment the results will probably be better than that, because he has a number of patients doing well under that time period.

In polycythemia vera there is no question but what P^{32} is the method of choice, causing little if any trouble to the patient, and proving effective for months or sometimes years. I have one patient that has not received any therapy for the past two years and still has a normal blood count, in the seventh year after initiation of treatment.

There has not yet been a full exploration of the short-lived isotopes which offer a chance of flooding the body with a very intense and very short-lived radiation in some forms of disseminated cancer. The Atomic Energy Commission is developing hospital set-ups at its national laboratories —Oak Ridge, Argonne in Chicago, Brookhaven in Long Island—where we hope to be able to test out these isotopes which cannot be transported any distance from the radioactive piles.

One of the tools very familiar to you is radium. Radium has always been expensive, and, if it once gets into the body, into the bloodstream, or into the tissues, it is extremely dangerous. You all recall the experience of the radium watch dial workers in New Jersey. It is of interest that in the radioactive isotope of cobalt, cobalt^{60}, we have a substance which gives off a three and a half million-volt type of gamma radiation with only a small amount of relatively soft beta radiation, relatively easily screened out, and virtually the equivalent of radium radiation. Also, if cobalt does accidentally gain access to the body, it is not toxic, because it is metabolized normally and is not permanently laid down in bone, as is the case with radium.

This new therapeutic tool will not ever completely supplant radium, but it un-

doubtedly will greatly amplify radium therapy. It will make available a much greater variety of applicators than could ever have been had in the past, and it will materially reduce the cost of the basic material. It has only one troublesome feature—its relatively short half life as compared to radium, five and a half years as against some 1,400 years.

One of the very important things that we need to achieve is a better understanding of how radiation works, what it does to the body, what it does to the cells of the body. We have gained in recent years, through the experience of working with tremendous masses of radioactive material, a better understanding of the effects of total body irradiation, a better understanding of the way in which the radiation affects single cells as well as the organism as a whole, but there is much still to be done, and you are in a very key position to aid in carrying out this work. As you observe the behavior of tumors, as you observe the behavior of normal tissues, you can add very materially to our knowledge as to what happens in the recovery process from irradiation, as to what the relative effect of a given dose of radiation delivered at one time and delivered serially may be, as to what recovery processes are of importance.

We know the relative susceptibility of different tissues, but we do not know the determining factors. We know that there are extraordinary variations between cells. We need a vast amount of experimental work as to how the variations are produced.

Take a specific protein, that of the ordinary fruit fly, with which the geneticists work so much, and we find an extraordinary situation. For the egg of the fruit fly the LD 50 is 150 to 160 r, but for the pupa the LD 50 is 150,000 r. What has happened to the specific protein of that insect to make it 1,000 times as resistant in the pupal stage as in the egg?

If we irradiate cells in tissue culture we can kill the bulk of the cells easily, but it will take a much larger dose to kill all. What is the difference? One can very frequently kill the bulk of the cells of a tumor in the first course of therapy, but if some are allowed to survive, the next time one tries to treat the recurrence with radiation its cells are much more resistant. Is this an acquired characteristic of these cells or is it simply that cells which had this power to survive initially have been selected out from the tumor and are making up the bulk of the recurrence?

In these days in which there is a possibility of mass exposure of human populations to radiant energy, it is of great importance to know the factors that underlie susceptibility and resistance to radiation. It is of vital importance to learn what we may do to cells, to the organism as a whole, to alter susceptibility, increasing it in case of tumor cells, decreasing it in the case of normal cells. You who are dealing with radiation every day, who see the effects of it, are in a key position to point out useful avenues of research in this field. You and those working with you are in key positions to carry out some of the most important aspects of this research.

I believe that the cancer problem is not an insoluble problem. We have already been able so to delineate it that we can see the rough shape that the answer may well take. I believe that with intensive work we can bring about a series of advances, so that quite possibly within our lifetime one will be able to look back on the days when patients were referred to the radiotherapist primarily for the alleviation of terminal results. One can see transition to the time when the bulk of cases will be cured rather than resulting in failure.

With you, after the general practitioner, lies more opportunity for effective control of cancer than with any other segment of our total population. As you perfect methods of diagnosis, as you perfect methods of therapy, I believe we can see real hope and that we can look to the day when cancer will be not the terminus but simply a serious incident of the life of those of our population unfortunate enough to encounter it. SHIELDS WARREN, M.D.

Radiological Defense

Wise measures for defense and for disaster preparedness in these times of atomic bombs and proposed atomic engines require solid scientific foundations. Two very fundamental questions are: What injuries will be caused by various doses of radiation? What antidotes and remedies are available to counteract radiation injuries?

The Fairchild Engine and Airplane Corporation, under contract to the U. S. Air Force for its NEPA[1] Project, employed a considerable panel of experts to explore these questions. Two compilations have resulted that are presumably so valuable for medical science that the Technical Information Division of the A.E.C. is undertaking to make them widely available. The titles are:

NEPA-1019, Tabulation of Available Data Relative to Radiation Biology, available now at a price of twenty cents.

NEPA-1127, Attempts to Prevent and Counteract Effects of Ionizing Radiations by Chemical and Pharmacological Means, will be available in July at a price, probably, of fifteen cents.

They may be had by sending the purchase price to Document Sales Agency, P. O. Box 62, Oak Ridge, Tennessee.

R. R. NEWELL, M.D.

[1] NEPA = Nuclear Energy for Propulsion of Aircraft.

MID-SUMMER CONFERENCE OF ROCKY MOUNTAIN RADIOLOGICAL SOCIETY

As previously announced, the Mid-Summer Conference of the Rocky Mountain Radiological Society will be held at the Shirley-Savoy Hotel, Denver, Colo., Aug. 17–19. The guest speakers and their subjects, as they appear on the program, are as follows:

Dr. George F. Lull, Secretary and General Manager, American Medical Association, Chicago
- (*a*) "Medical Economic Policies of the American Medical Association."

Dr. Eugene P. Pendergrass, Philadelphia
- (*a*) "Diagnosis of Cancer of the Breast and Comments Concerning the Role of Radiation in Its Treatment, and the Effects of Hormones on Breast Cancer."
- (*b*) "Meningiomas."
- (*c*) "Certain Considerations of the Roentgen Examination in the Diagnosis of Chest Lesions."

Dr. Orville Meland, Los Angeles
- (*a*) "Carcinoma of the Larynx."
- (*b*) "Radiodermatitis Resulting from Uncontrolled Fluoroscopy."

Dr. Knut Lindblom, Stockholm, Sweden
- (*a*) "Arthrography of the Knee."
- (*b*) "Myelography and Disc Puncture."
- (*c*) "Nervous Disturbances of the Urinary Bladder."

Dr. U. V. Portmann, President of the American Roentgen Ray Society, Cleveland, Ohio
- (*a*) "Cancer of the Breast; Classifying Cases and Manifestations of Incurability."
- (*b*) "Radiotherapy for Some Non-Malignant Conditions."
- (*c*) "Contact Roentgen Therapy for Superficial Lesions."

Other interesting papers will also be presented.

A cordial invitation is extended to all physicians interested in radiology to attend this conference. No registration fee is required.

ARIZONA ASSOCIATION OF PATHOLOGISTS AND RADIOLOGISTS

The newly elected officers of the Arizona Association of Pathologists and Radiologists are Maurice R. Richter, M.D., of Phoenix, President; Ralph H. Fuller, M.D., of Tucson, Vice-President; R. Lee Foster, 507 Professional Building, Phoenix, Secretary-Treasurer.

CHICAGO ROENTGEN SOCIETY

At a recent meeting of the Chicago Roentgen Society, the following officers were elected for the ensuing year: President, John H. Gilmore, M.D.; Vice-President, Frank L. Hussey, M.D.; Secretary, Benjamin D. Braun, M.D., 6 North Michigan Ave.

NEW YORK ROENTGEN SOCIETY

The officers of the New York Roentgen Society for 1950–51 are: President, Robert P. Ball, M.D.; Vice-President, Maurice Lenz, M.D.; Secretary, John L. Olpp, M.D., 49 Ivy Lane, Tenafly, N. J.; Treasurer, Irving Schwartz, M.D.

SOUTH CAROLINA X-RAY SOCIETY

At the May meeting of the South Carolina X-Ray Society, W. S. Judy, M.D., of Greenville, was elected President; Percy D. Hay, Jr., M.D., of Florence, Vice-President; S. H. Fisher, M.D., of Greenville, Secretary-Treasurer. The Society meets annually at the meeting of the State Medical Association and at other times at the call of the President.

WASHINGTON STATE RADIOLOGICAL SOCIETY

At a recent meeting of the Washington State Radiological Society the following officers were elected: President, Joseph M. Aspray, M.D., Spokane; Vice-President, Homer Hartzell, M.D., Seattle; Secretary-Treasurer, R. C. Kiltz, M.D., 705 Medical-Dental Bldg., Everett.

CANCER SEMINAR PENROSE CANCER HOSPITAL

On Sept. 9 a Cancer Seminar will be held at the Broadmoor Hotel, Colorado Springs, Colo., under the sponsorship of the Penrose Cancer Hospital and the Society of Clinical Pathologists of Colorado. Dr. Philip J. Hodes, Professor of Radiology at the University of Pennsylvania, and Dr. Lauren V. Ackerman, Associate Professor of Surgical Pathology at Washington University, St. Louis, will conduct the seminar. While the meeting is of particular interest to pathologists and radiologists, it is open to all interested physicians. There is no registration fee, but hotel reservations should be made in advance.

FOURTH INTER-AMERICAN CONGRESS OF RADIOLOGY

The Sociedad Mexicana de Radiologia y Fisioterapia has announced the formation of the following organizing committee for the Fourth Inter-American Congress of Radiology to be held in Mexico City in 1952: President, Dr. Manuel F. Madrazo; Secretary-General, Dr. Guido Torres Martinez; Secretary-General for Latin America, Dr. Narno

Dorbecker C.; Secretary-General for the United States and Canada, Dr. Guillermo Santin; Treasurer, Dr. Baudelio Villanueva.

SOCIEDAD COLOMBIANA DE RADIOLOGIA

The Sociedad Colombiana de Radiologia, with headquarters in Bogota, Colombia, was founded some five years ago and now has regional branches in the principal cities of the country. Meetings are held in Bogota monthly from March to November, with a general meeting each year in March. The honorary president of the Society is Dr. Gonzalo Esguerra-Gómez. The General Secretary is Dr. Alberto Torres Focke, Avenida 34 No. 17–34, Bogota, Colombia.

JOURNAL OF THE CANADIAN ASSOCIATION OF RADIOLOGISTS

There has recently been added to the list of periodical publications dealing specifically with radiology the *Journal of the Canadian Association of Radiologists*, the first number of which is dated March 1950. The new journal will appear quarterly. The members of the Editorial Board are J. W. McKay, M.D. (*Chairman*), Origène Dufresne, M.D., E. M. Crawford, M.D., and Carleton B. Peirce, M.D.

RADIOLOGY extends its congratulations and heartiest wishes for success to the Canadian Association in this new venture.

OAK RIDGE SUMMER SYMPOSIUM

The second annual Oak Ridge Summer Symposium, to be devoted to quantum and inorganic chemistry, will be held at Oak Ridge, Tenn., Aug. 21–31 under the joint sponsorship of the Oak Ridge National Laboratory and the Oak Ridge Institute of Nuclear Studies.

There will be no admission charge, but it is expected that those attending will arrange for their own traveling and living expenses. Additional information may be obtained from the University Relations Division, Oak Ridge Institute of Nuclear Studies, P. O. Box 117, Oak Ridge, Tenn.

A CORRECTION

In a review of the monograph by Herbert Graf on the recently revised safety regulations for the manufacture and installation of medical x-ray equipment, in Germany (DIN 6811 and 6812), appearing in the February 1950 issue of RADIOLOGY (page 285), the statement was made that these regulations, though established as a wartime measure, had been kept in effect to date because of shortage in critical materials. This, the author writes us, is incorrect. "The new German safety standards," he states, "...are definitely up to peacetime standards.... In order to mitigate matters during the war, exceptions were decreed in connection with the standards DIN 6811 and 6812...considering the shortage of certain raw materials and of labour. These mitigating regulations are still in effect, but only until July 1, 1950. After that date, said regulations will be fully in force."

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

THE AUTOBIOGRAPHY OF ROBERT A. MILLIKAN. A volume of 312 pages, with 16 photographs. Published by Prentice-Hall, Inc., New York, 1950. Price $4.50.

CYTOLOGIC DIAGNOSIS OF LUNG CANCER. By SEYMOUR M. FARBER, M.D., MILTON ROSENTHAL, M.D., EDWIN F. ALSTON, M.D., MORTIMER A. BENIOFF, M. D., and ALLEN K. MCGRATH, JR., M.D., from the University of California Medical Service and the Department of Pathology, San Francisco Hospital and the San Francisco Department of Public Health. A volume of 60 pages, with 60 illustrations in color. Published by Charles C Thomas, Springfield, Ill., 1950. Price $6.00.

MEDICAL PHYSICS. VOLUME II. Editor-in-Chief, OTTO GLASSER, Ph.D., F.A.C.R., Diplomate in Radiological Physics, American Board of Radiology; Professor of Biophysics, Frank E. Bunts Educational Institute; Head, Department of Biophysics, Cleveland Clinic Foundation; Consultant, U. S. Veterans Administration, Washington, D. C. Associate Editors: All contributors to Volumes I and II. Editorial Assistant, Jessie C. Tucker, Cleveland, Ohio. A volume of 1,228 pages, with 978 illustrations. Published by the Year Book Publishers, Inc., Chicago, Ill., 1950. Price $25.00.

SUPERVOLTAGE ROENTGENTHERAPY. By FRANZ BUSCHKE, M.D., SIMEON T. CANTRIL, M.D., and HERBERT M. PARKER, M.Sc. From the Tumor Institute of The Swedish Hospital, Seattle, Wash. A volume of 298 pages, with 260 illustrations, including 20 plates in color. Published by Charles C Thomas, Springfield, Ill., 1950. Price $10.50.

THE MERCK MANUAL OF DIAGNOSIS AND THERAPY. A SOURCE OF READY REFERENCE FOR THE PHYSICIAN. A volume of 1,592 pages. Published

by Merck & Co., Inc., Rahway, N. J., 8th ed., 1950. Price $4.50.

X-RAYS (Methuen's Monographs on Physical Subjects). By B. L. WORSNOP, B.Sc., Ph.D., and F. C. CHALKLIN, Ph.D., D.Sc. A volume of 126 pages, with 47 diagrams. Published by John Wiley & Sons, Inc., New York. Price $1.25.

CANCER OF THE BREAST. A CLINICAL STUDY OF 1042 CASES TREATED AT RADIUMHEMMET, 1936–1941. Acta Radiologica Supplementum 77. By BENGT A. NOHRMAN. A monograph of 98 pages, with 64 tables. Esselte Aktiebolag, Stockholm, 1949. Price, Swed. Crowns 15.

DETERMINATION OF PHYSICAL FACTORS INFLUENCING THE QUALITY OF THE RADIOGRAPHIC IMAGE (THE REPRODUCTION NUMBER METHOD AND ITS APPLICATION). Acta Radiologica Supplementum 76. By ARNE NELSON. A monograph of 88 pages, with 24 illustrations. Esselte Aktiebolag, Stockholm, 1949. Price, Swed. Crowns 15.

DER ULTRASCHALL IN DER MEDIZIN. KONGRESSBERICHT DER ERLANGER ULTRASCHALL-TAGUNG 1949. Herausgegeben im Auftrage der Ultraschall-Arbeitsgemeinschaft von den Veranstaltern der Tagung: PROF. DR. K. MATTHES, Direktor der medizinischen Universitätsklinik, Erlangen, und PROF. DR. W. RECH, komm. Leiter der Universitätsfrauenklinik, Erlangen. Für den Druck, überarbeitet von DR. F. WACHSMANN. A volume of 476 pages. Published by S. Hirzel, Zürich, 1949.

DIE ENTWICKLUNG DER LUNGENTUBERKULOSE IM RÖNTGENBILD. By PROF. DR. ERICH ZDANSKY, Chief, Zentral-Rontgeninstitut am Allgemeinen Krankenhaus in Wien. A monograph of 68 pages, with 70 illustrations. Published by Springer, Wien, 1949. Distributed in the United States by Walter J. Johnson, Inc., New York. Price $3.00.

Book Reviews

THE 1949 YEAR BOOK OF RADIOLOGY. Radiologic Diagnosis, edited by FRED JENNER HODGES, M.D., and JOHN FLOYD HOLT, M.D. Radiation Therapy, edited by ISADORE LAMPE, M.D. A volume of 454 pages, with 393 illustrations. Published by the Year Book Publishers, Chicago, Ill. Price $6.50.

The latest Year Book of Radiology presents, in something less than 500 pages, abstracts of the significant papers on radiologic diagnosis and radiotherapy appearing between June 1948 and June 1949. Editorially it is a product of the University of Michigan. Dr. Fred J. Hodges and Dr. John F. Holt, who became editors of the Diagnostic Section in 1948, have continued in that capacity, while Dr. Isadore Lampe has succeeded Dr. Ira Kaplan as editor of the Therapy Section.

As would be expected, a large proportion of the material is drawn from the strictly radiological literature, but the other specialty publications and general medical journals are represented by a good selection of papers. Of special interest technically in the period covered is the work on the amplification of the fluoroscopic image, while in the field of therapy special emphasis has been placed on the biologic assay of radiation effects and continued studies with radioactive isotopes. For the majority of practising radiologists, however, the clinical contributions will probably continue to have the greatest appeal. Upon the wise selection of these, the work depends largely for its usefulness.

In format the volume closely resembles its predecessors. It is liberally illustrated and the reproductions are excellent. Especially to be commended is the uniform presentation of the roentgenograms in the form of the negatives, though the densities may have been reversed in the original paper.

Radiologists may continue to look to this publication for current trends of thought and practice in their specialty.

CANCER. A MANUAL FOR PRACTITIONERS. A volume of 308 pages. Committee on Publication: Ernest M. Daland, M.D., Chairman; Sidney Farber, M.D., George W. Holmes, M.D.; Channing C. Simmons, M.D., Editor; Merrill C. Sosman, M.D.; and Shields Warren, M.D. Published by the American Cancer Society (Massachusetts Division), Inc., 462 Boylston St., Boston 16, Mass., 2nd ed., 1950. Price $2.00. In lots of 100 or more, $1.50 per copy.

The second edition of the Cancer Manual of the American Cancer Society (Massachusetts Division) is a rewritten augmented version of the Manual originally published in 1940 "to aid the general practitioner in the diagnosis of cancer and to suggest the methods of therapy generally accepted as best." This type of medical writing is difficult, since it demands that these problems be placed in their proper perspective. Radiotherapists and cancer surgeons may find that this "long view" makes stimulating reading.

Seven introductory chapters provide the backdrop for specific discussions: "Historical Trends in Cancer," "Modern Cancer Research," "Biopsy in Relation to Tumor Diagnosis," and others. These are followed by consideration of tumors of specific types and specific regions, with concluding chapters on known etiologic factors, hormone therapy, and patient-care in advanced cancer.

The manual is recommended as expert perspective writing.

BETEKENIS EN BEPALING VAN DE SKELETLEEFTIJD. By DR. BERNARD SPEIJER, Rotterdam, Holland. A volume of 154 pages, with 210 illustrations. With a summary and legends in both English and French. Published by Eduard Ijdo N.V., Leiden, 1950.

In this publication from Leiden, Holland, the author summarizes the literature concerning the factors which influence skeletal development and presents radiological studies of 360 healthy children. He believes that skeletal development proceeds in two waves. Following the initial wave, there is an interval at eight to nine years in girls during which growth proceeds very slowly, and at ten to twelve years in boys when it is practically arrested. In both sexes development is resumed in the preadolescent period.

The monograph is written in Dutch, but in the Atlas presenting the author's radiological observations the legends have been translated into both English and French.

LA RADIOTERAPIA DEI FIBROMIOMI UTERINI IN RAPPORTO AGLI ALTRI METODI TERAPEUTICI. By DR. GIOVANNI GARDELLA, Istituto di Radiologia dell'Universita di Genova. Director: Prof. Allesandro Vallebona. A monograph of 64 pages. Published by Vergine di Pompei, Genova, Italy, 1948.

This monograph summarizes the voluminous literature which has been collected up to now on the treatment of fibromyomata of the uterus. The author states that the radiological treatment of fibromyomata should be given preference over surgery because the results are good and the mortality practically non-existent. He stresses, however, the necessity for accurate diagnosis to exclude other conditions which may give the same symptoms but in which surgical treatment is definitely indicated.

ESTUDIO RADIOLÓGICO DEL ESÓFAGO [RADIOLOGICAL STUDY OF THE ESOPHAGUS]. By Q. CODAS THOMPSON, Professor of Radiology of the Faculty of Medical Sciences, Asunción, Paraguay, L. ZUBIAURRE, Assistant Professor of Radiology, Faculty of Medicine, Montevideo, AND E. ZERBONI, Chief Radiologist of the Hospital Saint-Bois, Member of the Staff of the Institute of Radiology and Physical Sciences, Montevideo. A volume of 350 pages, with 128 radiographic illustrations. Published by the Instituto de Radiología y Ciencias Físicas (under the direction of Professor Pedro A. Barcia) of the Faculty of Medicine of Montevideo, Uruguay, 1949.

To those of our colleagues who have not had the privilege of visiting our sister republics south of the equator, this book will be an eye-opener, as it is typical of a group of interesting and valuable contributions to radiological literature which have emanated from Latin-American centers of radiology. This is the first of a series of publications honoring the great masters who have contributed importantly to the progress of clinical radiology. This particular monograph is dedicated to Professor Hans Heinrich Berg.

The authors realize that the theme is an old one, indeed one of the earliest to receive attention from radiologists, but even with old themes it is appropriate from time to time to halt for a moment to analyze the way over which progress has been made, to assay experience acquired, to evaluate the different stages of evolution through which our concepts have been formed, and to deduce new methods of approach to the problems of the future.

The Institute of Radiology and Physical Sciences of the Faculty of Medicine of Montevideo, under the direction of Professor Pedro A. Barcia, has been in the van of radiological progress for more than a quarter of a century. The reviewer from personal observation can testify to the excellence of the radiological work being done and to the intellectual integrity of the individual workers, and any publication emanating from this center stands at once highly recommended to radiologists the world over.

This particular work is divided into four parts. Part I relates to the technic of the examination. Part II discusses the normal esophagus. Parts III and IV deal exhaustively with the various diseases of the esophagus and the gastric fundus. There is a very good bibliography at the close of each chapter. The authors have not only drawn widely upon the world literature, but the various chapters of this work show to what a large extent they have drawn upon their personal experiences.

ANTONIO A. CENTRÁNGOLO. By DR. ANGEL N. BRACCO, Faculty of Medicine of Montevideo. Published by the Institute of Radiology and Physical Sciences, under the direction of Professor P. A. Barcia. Sixty pages; one photograph. Editorial Florensa and Lafon, Montevideo, 1950.

This biography of Dr. Antonio A. Centrángolo is written by one of his former colleagues in the Institute of Radiology and Physical Sciences of the Faculty of Medicine of Montevideo, directed by Professor Pedro A. Barcia. The practice of this Institute of putting out several times a year monographs, sometimes amounting to textbooks, on various subjects of radiologic interest is to be highly commended. Professor Barcia can be very proud of the group of young men who have worked for a greater or less time with him and have contracted some of his zeal for research and teaching. His students have scattered to various parts of Latin America, so that the inspiration and influence of the life of this exceptional teacher have been widely disseminated.

The series of biographies to which the present

volume belongs is a very nice gesture. Dr. Centrángolo was especially known for his work in phthisiology. For many years he carried on his activities in Cordoba and vicinity but in 1940 he returned to Buenos Aires, where he rehabilitated the Central National Hospital for Tuberculosis. His own book, *Thirty Years of Treating Tuberculosis*, was written while he was director of this hospital.

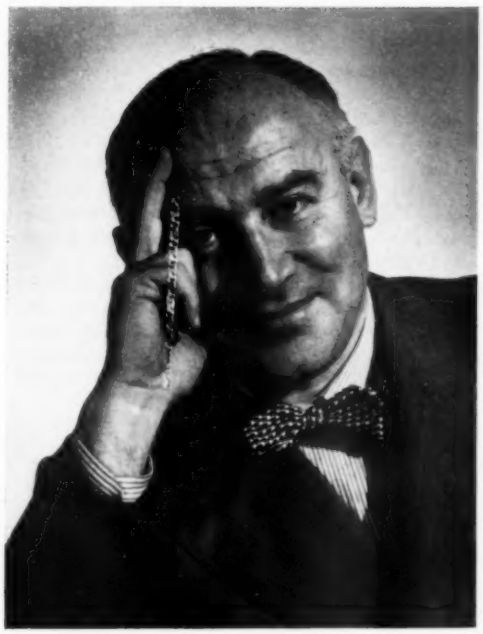
The present volume is beautifully written and printed in a dignified and attractive fashion.

In Memoriam

FRANK S. WINDHOLZ, M.D.

Dr. Frank S. Windholz died at his home in San Francisco on April 29, 1950, at the age of fifty-two, after twelve years in America.

Dr. Windholz was born in Austria, the son of a physician, was educated in Graz, Hungary, and spent some seven years in the field of pathology, holding an appointment at the University of Vienna. He then turned to radiology, working at the Central Roentgen Institute of the Allgemeinekrankenhaus. In 1932, following the death of Dr. Holzknecht, Dr. Windholz took over the private practice of that renowned radiologist, though still maintaining his connection with the Allgemeinekrankenhaus. He came to America in 1938, spent a year of internship in Colorado, and was licensed to practice in 1943. In the latter year he went to California and there was appointed Instructor in the Department of Radiology at Stanford University. He was subsequently advanced to Assistant Professor, and though at the time of his death he was engaged in private practice, he continued to do some teaching, with the rank of Assistant Clinical Professor of Radiology.



Frank S. Windholz, M.D.

Dr. Windholz had a deep interest in medical science and particularly in radiology. In spite of the burden of routine duties he found time for serious investigative work and contributions to the literature. Particularly noteworthy are his studies of the mastoid, begun in Vienna under Professor Maier and continued in this country with the collaboration of Dr. Hal Fletcher.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Hugh F. Hare, M.D., 605 Commonwealth Ave., Boston 15, Mass.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Philadelphia, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6, Ill.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago 37, Ill.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. D. Anderson, M.D., 420 10th St., Tuscaloosa.

Arizona

ARIZONA ASSOCIATION OF PATHOLOGISTS AND RADIOLOGISTS. *Secretary*, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Sydney F. Thomas, M.D., Palo Alto Clinic, Palo Alto.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Harold P. Tompkins, M.D., 658 South Westlake Ave. Meets monthly, second Wednesday, County Society Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, Clifford W. Wauters, 701 High St., Auburn. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with State Medical Association.

SAN DIEGO ROENTGEN SOCIETY. *Secretary*, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego. Meets first Wednesday of each month.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Merrell A. Sisson, M.D., 450 Sutter St., San Francisco 8. Meets third Thursday at 7:45, January to June at Stanford University Hospital, July to December at San Francisco Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Paul E. RePass, M.D., 306 Republic Bldg., Denver 2. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Fred Zaff, M.D., 135 Whitney Ave., New Haven. Meetings bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Ellwood W. Godfrey, M.D., 1676 Boulevard, W. Hartford. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, Karl C. Corley, M.D., 1835 Eye St., N.W., Washington 6. Meets third Thursday, January, March, May, and October, at 8:00 P.M., in Medical Society Auditorium.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John J. McGuire, M.D., 1117 N. Palafox, Pensacola. Meets in April and in November.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary*, David Kirsh, M.D., 712 duPont Bldg., Miami 32. Meets monthly, last Wednesday, 8:00 P.M.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Ted F. Leigh, M.D., Emory University Hospital. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert C. Pendergrass, M.D., Americus. Meets in November and at the annual meeting of State Medical Association.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, Benjamin D. Braun, M.D., 6 N. Michigan Ave., Chicago 11. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly as announced.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Harold L. Shinall, M.D., St. Joseph's Hospital, Bloomington.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*. William M. Loehr, M.D., 712 Hume-Mansur Bldg., Indianapolis 4. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary*, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Anthony F. Rossitto, M.D., Wichita Hospital, Wichita. Meets annually with State Medical Society.

Kentucky

LOUISVILLE RADIOLOGICAL SOCIETY, *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel.

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary*, J. Howard Franz, M.D., 1127 St. Paul St., Baltimore 2.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, George Belanger, M.D., Harper Hospital, Detroit 1. Meetings first Thursday, October to May, at Wayne County Medical Society club rooms.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building, Flint 3.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, Leo A. Nash, M.D., 572 Lowry Medical Arts Bldg., St. Paul 2. Meets in Spring and Fall.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City 6, Mo. Meetings last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, H. R. Senturia, M.D., Pasteur Medical Bldg. Meets on fourth Wednesday, October to May.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John E. Downing, M.D., 816 Medical Arts Bldg., Omaha. Meets fourth Thursday of each month at 6 P.M. in Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, George Levene, M.D., Massachusetts Memorial Hospitals, Boston. Meets monthly on third Friday at the Harvard Club.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene. Meetings quarterly in Concord.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Benjamin Copleman, M.D., 280 Hobart St., Perth Amboy. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway.

BROOKLYN ROENTGEN RAY SOCIETY. *Secretary*, J. Daversa, M.D., 603 Fourth Ave., Brooklyn. Meets fourth Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*. Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10. Meetings January, May, October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening, October to May, at 8:45 P.M., in Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY. *Secretary*, John L. Olpp, M.D., 49 Ivy Lane, Tenafly, N. J.

QUEENS ROENTGEN RAY SOCIETY. *Secretary*, Jacob E. Goldstein, M.D., 88-29 163rd St., Jamaica 3. Meets fourth Monday of each month.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, A. Vaughn Winchell, M.D., 40 Meigs St. Meets at Strong Memorial Hospital, last Monday of each month, September through May.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, James E. Hemphill, M.D , Professional Bldg., Charlotte 2. Meets in May and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Charles Heilman, M.D., 807 Broadway, Fargo.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Edward C. Elsey, M.D., 927 Carew Tower, Cincinnati 2. Meets with State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Frank A. Riebel, M.D., 15 W. Goodale St., Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

CINCINNATI RADIOLOGICAL SOCIETY. *Secretary*, E. C. Elsey, M.D. Meets last Monday, September to May.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Hannan,M.D., 10515 Carnegie Ave., Cleveland 6. Meetings at 6:45 P.M. on fourth Monday, October to April, inclusive.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Geo. A. Nicoll, M.D., Miami Valley Hospital, Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. E. Brown, M.D., 21st and Xanthus, Tulsa 4. Meets in October, January, and May.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Selma Hyman, M.D., University of Oregon Medical School, Portland. Meets monthly, on the second Wednesday, at 8:00 P.M., in the library of the University of Oregon Medical School.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, George P. Keefer, M.D., American Oncologic Hospital, Philadelphia 4. Meets first Thursday of each month at 8:00 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Edwin J. Euphrat, M.D., 3500 Fifth Ave., Pittsburgh 13. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at Webster Hall.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maurice D. Frazer, M.D., Lincoln Clinic, Lincoln, Nebr.

South Carolina

SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, S. H. Fisher, M.D., 107 E. North St., Greenville. Meets with the State Medical Association in May and at the call of the President.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Marianne Wallis, M.D., 1200 E. Fifth Ave., Mitchell. Meets with State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. Meetings second Tuesday of each month at University Center.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth 2. Meets monthly, third Monday, in Dallas odd months, Fort Worth even months.

HOUSTON X-RAY CLUB. *Secretary*, Curtis H. Burge, M.D., 3020 San Jacinto, Houston 4. Meetings fourth Monday of each month.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting, Jan. 19-20, 1951, in Galveston.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., Norfolk General Hospital, Norfolk.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. C. Kiltz, M.D., 705 Medical-Dental Bldg., Everett. Meetings fourth Monday, October through May, at College Club, Seattle.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Theodore J. Pfeffer, M.D., 839 N. Marshall St., Milwaukee 2. Meets monthly on second Monday at the University Club.

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee. Meets in May and with State Medical Society, September.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursdays 4 P.M., September to May, Service Memorial Institute, Madison 6.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irving I. Cowan, M.D., 425 East Wisconsin Ave., Milwaukee 2.

Puerto Rico

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary*, Jesús Rivera Otero, M.D., Box 3542, Santurce, Puerto Rico.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, E. M. Crawford, M.D. Associate Honorary Secretary-Treasurer, Jean Bouchard, M.D. *Central Office*, 1535 Sherbrooke St., West, Montreal 26, Quebec. Meetings in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origène Dufresne, M.D., Institut du Radium, Montreal. Meets third Saturday each month.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPIA. *General Secretary*, Dr. Dionisio Pérez Cosío, Marsella 11, México, D. F. Meetings first Monday of each month.

PANAMA

SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86, Panama, R. de P.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

CASAMAJOR, LOUIS, ET AL. Validity of Pneumoencephalographic Diagnosis. A Study of 500 Pneumoencephalograms in Children... 136

BIELAWSKI, JOHN G., AND TATELMAN, MAURICE. Intracranial Calcification in Encephalotrigeminal Angiomatosis... 136

BRAAF, MURRAY M. Migraine Headache Treated Successfully by Head-Traction Manipulation and Thiamin Chloride... 136

CURTIS, J. B. Rapid Serial Angiography: Preliminary Report... 137

WILKINSON, M., ET AL. Percutaneous Carotid Angiography: A Team Technique, with a Report of the Results in 70 Cases... 137

PATERNO, RAMON, ET AL. Cerebral Angiography. Preliminary Report... 137

PENMAN, JOHN. A Simple Radiological Aid to Gasserian Injection... 137

MINO, ROBERT A., ET AL. Giant Pharyngoesophageal Diverticulum... 137

The Chest

BOYDEN, EDWARD A. Cleft Left Upper Lobes and the Split Anterior Bronchus... 138

WARRING, FREDERICK C., JR. Simple Tests of Ventilatory Function for Use in the Sanatorium or Clinic... 138

DE MORAES, R. BELLO, AND DE CARVALHO, SÉRGIO. Arteriovenous Communications in the Lungs: New Method of Study... 138

EVANS, WILLIAM A., JR. Congenital Obstructions of the Respiratory Tract. I. Tracheal Malformations... 138

EVANS, WILLIAM A., JR. Congenital Obstructions of the Respiratory Tract. II. Bronchial Malformations... 139

BROMBART, M. Lipiodol Bronchography from the Radiologic Point of View... 139

DROUET, P.-L., ET AL. Bronchial Lipiodol in Pulmonary Emphysema... 139

LETT, JAMES E., AND DIETZ, M. WENDELL. Bronchography in the Severely Discharging Lung... 140

STORRS, RICHARD P., ET AL. Lipoid Granuloma of the Lung Following Bronchography with Iodized Oil... 140

CARR, DUANE, ET AL. Physiological Significance of Bronchiectasis... 140

MOORE, J. R., ET AL. Bronchiectasis: A Study of the Segmental Distribution of the Pathologic Lesions... 140

GOODRICH, BEN E., AND JOHNSON, THOMAS D. Chronic Bilateral Basal Pulmonary Fibrosis 140

GOLDEN, ALFRED, AND TULLIS, I. FRANK, JR. Diffuse Interstitial Fibrosis of the Lungs... 141

PEROMET. Intrabronchial Lipiodol in the Images Called "Fibrosis of the Right Base"... 141

BENDA, R., ET AL. Pulmonary Syphilis... 141

RICKER, WALTER, AND CLARK, MARDELLE. Sarcoidosis. A Clinicopathologic Review of 300 Cases, Including 22 Autopsies... 141

WELLENS, P., AND BAYENS, J. Correlation of Clinical and Radiologic Findings in Besnier-Boeck-Schaumann Disease... 142

CARDIS, F. Recent Experimental Studies of Pulmonary Ascaridiasis... 143

HAGER, HERBERT F., ET AL. Nocardiosis. Pneumonia and Empyema Due to Nocardia Asteroides... 143

FAINSINGER, M. H. Pulmonary Hydatid Disease. The Sign of the Camalote... 144

GROSS, ROBERT J., AND SCHAEFER, FRANKLIN H. Basal Tuberculosis Simulating Sub-Phrenic Abscess... 144

BEATTY, OREN A., AND HORST, JOHN V. Tuberculosis Control in Ohio State Reformatory... 144

MIDDLEMISS, J. H. Erythema Nodosum... 144

RITVO, MAX, AND MARTIN, FRANCIS. Clinical and Roentgen Manifestations of Pneumonia Due to Bacillus Mucosus Capsulatus (Primary Friedländer Pneumonia)... 144

FREEDMAN, BENJAMIN. Pulmonary Adenomatosis... 145

HORNER, JOHN L. Premature Calcification of the Costal Cartilages: Its Frequent Association with Symptoms of Non-organic Origin... 145

HARDY, L. MARTIN. Bronchogenic Cysts of the Mediastinum... 145

KNEIDEL, JOHN H. Case of Aneurysm of the Ductus Arteriosus with Postmortem Roentgenologic Study After the Instillation of Barium Paste... 145

The Digestive System

JOHNSTONE, A. S., D'ABREU, A. L., FAWCITT, RICHARD, EDWARDS, HAROLD C., GROUT, J. L. A., AND WELLS, CHARLES. Symposium—Diverticula of the Alimentary Tract... 146

BREWER, LYMAN A., III, AND DOLLEY, FRANK S. Carcinoma of the Thoracic Esophagus. A Discussion of Early Diagnosis and Surgical Treatment... 147

CRUMP, ARMISTEAD B., AND HENNIG, GEORGE C. Diagnosis of Carcinoma of the Esophagus: The Method of Biopsy with the Retrograde Curette... 147

BERNE, CLARENCE J., AND GIBSON, WILLIAM R. Giant Hypertrophic Gastritis... 148

BONORINO UDAONDO, CARLOS, ET AL. Prolapse of the Gastric Mucosa into the Duodenal Bulb 148

MELAMED, MYRON, AND MELAMED, ABRAHAM. Prolapsed Gastric Mucosa: A Possible Cause of "Gastric" Symptoms in Right Heart Failure 148
REISMAN, HENRY A., AND WOLK, ARTHUR D. Chronic Intussusception 149
POOL, R. M. An Unusual Experience with the Miller-Abbott Tube 149
SWENSON, ORVAR, ET AL. New Concepts of the Etiology, Diagnosis, and Treatment of Congenital Megacolon (Hirschsprung's Disease) 149
CANÓNICO, ABEL N. Double Cancer of the Large Intestine 150
STAPLETON, J. G. Submucous Lipoma of the Colon 150
BERMAN, VICTOR. "Porcelain" Gall Bladder, Renal Calculi, and Unusually Large Bladder Calculi 150
NOSKIN, EUGENE A., ET AL. Spontaneous Internal Biliary Fistula 150
ARKIN, AARON, AND WEISBERG, S. W. Carcinoma of the Pancreas, A Clinical and Pathologic Study of 75 Cases 150
LOW, J. RICHMOND, ET AL. Meconium Peritonitis 151

The Spleen

ELLISON, EDWIN H. Spontaneous Rupture of the Diseased Spleen 151

The Adrenals

GOLDSTEIN, HAROLD M. Cushing's Syndrome Due to Tumor of Adrenal Cortex 151

The Musculoskeletal System

MCSWAIN, BARTON, ET AL. Ewing's Tumor 152
DE AZEVEDO GOMES, MANUEL. Osteoid Osteoma. Presentation of 22 Cases 152
MILLER, DAVID, AND BIRSNER, J. W. Coccidioidal Granuloma of Bone 152
JEANMART, J., AND MORIAMÉ, G. Atypical Multiple Myeloma 152
GRAUBARD, DAVID J., AND RITTER, HENRY H. Isolated Fracture of the Atlas 152
RAVEN, RONALD W., AND WILLIS, R. A. Solitary Plasmocytoma of the Spine 152
HARRISON, STEWART H. Painful Shoulder. Significance of Radiographic Changes in the Upper End of the Humerus 153
JONES, G. BLUNDELL. Painful Shoulder. Calcification of the Supraspinatus Tendon 153
HERDNER, R. Tomographic Study of the Adult Sternum and Sternoclavicular Articulations (Three Cases of Osteo-articular Tuberculosis). 153

Gynecology and Obstetrics

LOVELADY, SIM B., AND DOCKERTY, MALCOLM B. Extragenital Pelvic Tumors in Women 153
LABORDE, SIMONE, AND MONTAGNON, JEAN. Hysterography (In Cervical Cancer) 154
WILLIAMS, E. ROHAN, AND ARTHURE, HUMPHREY G. E. Further Radiological Studies in the Investigation of Obstetric Disproportion with Especial Reference to the Contracted Pelvic Outlet 154
KANTOR, HERMAN I., ET AL. The Urinary Bladder During Labor 155

The Genito-Urinary System

TRUCHOT. Observations on the Technique and Interpretation of Intravenous Urograms 155
VAN USSEL, E. M. Value of Upright Films in Intravenous Urography 156
STONE, ERIC P. Pancreatic Cysts Simulating Renal Disease 156
SHEARER, THOMAS P. Retrocaval Ureter. Report of a Case with Successful Plastic Repair 156
SMYRNIOTIS, P. C. Twenty-four Years of Radiologic Diagnosis of Bilharziasis in Egypt 156
STEWART, B. LYMAN, AND NICOLL, GORDON A. Cyst of the Seminal Vesicle 156

The Spinal Cord

SVIEN, HENDRIK J., ET AL. Multiple Primary Tumors of the Spinal Cord 157
CULVER, GORDON J., ET AL. Calcification in Intraspinal Meningiomas 157

The Blood Vessels

DUCUING, J., ET AL. Abdominal Aortography (Technic, Incidents and Accidents, Indications, Results) 157
BOYD, A. M., ET AL. Intermittent Claudication .. 158

Technic

LENZI, MARIO. Rotatory Kymography from Multiple Centers 158
AYRES DE SOUSA. Technical Principles of Regmography 158
GODENNE. New Apparatus for Preparation of Radiographic Stereoscopic Pairs of Small Format and Explanation of a Procedure for Obtaining the Radiographs, Posterior View, without Change of Position 158
PAPA, DOMENICK. X-Ray Diagnostic Agents—2-(3,5-Diiodo-4-Hydroxybenzyl)-Benzoic Acid 159

RADIOTHERAPY

SCOTT, R. KAYE. Pre-operative Radiotherapy in the Treatment of Osteogenic Sarcoma: Preliminary Report 159
HOLMES, H. R. Spinal Haemangioma Treated by Deep X-Ray Therapy 159
GORFAIN, A. D. Extramedullary Plasmacytoma of the Bladder with Local Metastasis. 159
WALLACE, WILLIAM S. Reticulo-Endotheliosis. Hand-Schüller-Christian Disease and the Rarer Manifestations 159

PROUZET, J., AND ESCANDE. Value of Roentgen Therapy in the Treatment of Whooping Cough 160
KOCH, H. W., AND CARTER, R. E. Determination of the Energy Distribution of Bremsstrahlung [X-Rays] from 19.5 Mev Electrons 160
BOSTWICK, W. H. Possible Techniques in Direct-Electron-Beam Tumor Therapy 160

RADIOISOTOPES; ELEMENT 97

QUIMBY, EDITH H., AND WERNER, SIDNEY C. Late Radiation Effects in Roentgen Therapy for Hyperthyroidism. Their Possible Bearing on the Use of Radioactive Iodine 160
PRINZMETAL, MYRON, ET AL. Problem Cases of Toxic Diffuse Goiter Treated with Radioactive Iodine 161
NACHMAN, HERMAN M., ET AL. Radioactive Iodine (I^{131}) in the Diagnosis of Lingual Thyroid 161
STEVENS, CHARLES D., ET AL. Distribution of Radioactive Iodine in Rats With and Without Walker Tumor 256 After Injection of Radioactive Sodium Iodide 161
COLIEZ, ROBERT. Use of Cobalt^{60} in Radiotherapy 161
THOMPSON, S. G., ET AL. Element 97 162

EFFECTS OF RADIATION

PENNYBACKER, JOE, AND RUSSELL, DOROTHY S. Necrosis of the Brain Due to Radiation Therapy. Clinical and Pathological Observations 162
RUSSELL, DOROTHY S., ET AL. Experimental Radio-Necrosis of the Brain in Rabbits 162
ARNOLD, HARRY L., JR. Erythema Multiforme Following High Voltage Roentgen Therapy. Review of the Literature and Report of Three Cases 162
PERUSSIA, ALDO. Contact Therapy in Chronic Professional Radiodermatitis 162
GUZMAN BARRON, E. S., ET AL. Studies of the Mechanism of Action of Ionizing Radiations. IV. Effect of X-Ray Irradiation on the Respiration of Sea Urchin Sperm. V. Effect of Hydrogen Peroxide and of X-Ray Irradiated Sea Water on the Respiration of Sea Urchin Sperm and Eggs 163
BALI, TALIA, AND FURTH, JACOB. Morphological and Biological Characteristics of X-Ray Inducted Transplantable Ovarian Tumors 163
TULLIS, JOHN L. Radioresistant Cells in Certain Radiosensitive Tissues of Swine Exposed to Atomic Bomb Radiation 163
HOLMES, BARBARA E. Indirect Effect of X-Rays on the Synthesis of Nucleic Acid in Vivo 163
FIELD, JOHN B., AND REKERS, PAUL E. Studies of the Effects of Flavonoids on Roentgen Irradiation Disease. I. Protective Influence of Rutin in Irradiated Dogs 163
FIELD, JOHN B., AND REKERS, PAUL E. Studies of the Effects of Flavonoids on Roentgen Irradiation Disease. II. Comparison of the Protective Influence of Some Flavonoids and Vitamin C in Dogs 164

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Validity of Pneumoencephalographic Diagnosis. A Study of Five Hundred Pneumoencephalograms in Children. Louis Casamajor, Robert W. Laidlaw, and Philip J. Kozinn. J. A. M. A. **140:** 1329–1330, Aug. 27, 1949.

In a study of 500 pneumoencephalograms of children, the authors have attempted to evaluate the indications for this procedure. They conclude that it is a method of neurosurgical not neurologic diagnosis, and that any therapeutic indications revealed by it are of necessity neurosurgical. It shows only (1) the size, shape, and position of the ventricles; (2) the size and shape of the basal cisterns, and (3) in some cases, the pattern of the cerebral convolutions and sulci. The primary and enforcing indications are (*a*) signs of increased intracranial pressure without localizing signs, although in many of these cases ventriculography is the method of choice, and (*b*) increasing focal cerebral signs in the absence of increased intracranial pressure.

In most cases of epilepsy or the convulsive state, pneumoencephalography has little to offer in clarifying the diagnosis or indicating the treatment. In the epilepsies, at least two of the following conditions should be present to justify the procedure: (1) that the convulsions are always or predominantly one-sided and occur always on the same side; (2) that there are positive neurologic signs on the side of the convulsions; (3) that the electroencephalogram discloses abnormal signs only or predominantly on the side opposite the side of the convulsions and physical signs; (4) that the convulsions and other signs are increasing in frequency or severity or both. In 88 per cent of 250 patients with epilepsy in the series studied, the clinical diagnosis and treatment were unchanged by the encephalographic observations. In 6 per cent, where the possibility of a brain tumor or subdural hematoma was entertained, the diagnosis was clarified by the elimination of these possibilities.

When tumors of the brain are suspected, pneumoencephalography is a necessary diagnostic technic. It usually verifies, localizes, or rules out neoplasms. However, in 21 per cent of the authors' cases in which a definite neoplasm existed, the encephalogram did not reveal the tumor.

In post-traumatic and post-infectious syndromes, encephalograms are not, in general, revealing. The series studied included 35 instances of the former and 40 of the latter. The chief finding in each group was cerebral hypoplasia.

The study included approximately 150 cases of congenital anomalies, mental retardation and miscellaneous lesions. In 65 per cent of this group pathologic findings were reported by the roentgenologist. Although about 59 per cent of the patients displayed only cerebral hypoplasia, many interesting lesions were uncovered by the encephalogram in the other 6 per cent. The clinical diagnosis of hydrocephalus was changed in one case to agenesis of the corpus callosum and in a second to cerebral atrophy. Pronounced examples of cerebral and cerebellar atrophy, microcephaly, hydrocephalus, and various structural anomalies were visualized.

The findings in the mentally deficient group showed little correlation between the brain structure and intelligence. They led to the conclusion that there is no indication for pneumoencephalography in persons who are mentally defective unless they also show signs of growing focal lesions of the brain. It is of little practical importance to know what sort of brain, as shown by pneumoencephalography, a mentally defective person has; that is the brain with which he must go through life, and gas studies will not alter the prognosis or treatment in the slightest.

Two tables.

DANIEL WILNER, M.D.
Atlantic City, N. J.

Intracranial Calcification in Encephalotrigeminal Angiomatosis. John G. Bielawski and Maurice Tatelman. Am. J. Roentgenol. **62:** 247–251, August 1949.

A case of Sturge-Weber syndrome in a 29-year-old female showing mental deficiency, diffuse unilateral calcification outlining the cortical convolutional margins of the posterior cerebral surface, ipsilateral facial nevus, and contralateral spastic hemiplegia is presented.

Ninety per cent of the reported cases of Sturge-Weber syndrome in which roentgenograms of the skull were obtained are said to have shown intracranial calcification. This may take the form of sinuous, parallel linear streaks and ring shadows, such as are seen in the meningeal angiomata, or may be of the more characteristic type observed in the present case, outlining the contours of a part or all of the cortex of one cerebral hemisphere. This latter type is apparently produced by calcific deposits in the atrophic layers of the cortex.

Encephalotrigeminal angiomatosis is grouped with tuberous sclerosis, neurofibromatosis, and neuro-ocular angiomatosis because of the embryological and clinical similarities exhibited by these neurocutaneous syndromes. Although intracranial calcification may occur in any of them, the type conforming to the cerebral convolutional pattern is typical only of encephalotrigeminal angiomatosis.

Two roentgenograms; 2 photographs.

J. A. CAMPBELL, M.D.
Indiana University

Migraine Headache Treated Successfully by Head-Traction Manipulation and Thiamin Chloride. Murray M. Braaf. New York State J. Med. **49:** 1812–1816, Aug. 1, 1949.

The basis for this paper is the author's belief that migraine is probably due to herniation of the cervical intervertebral disks which, by compression, cause a neuritis (radiculitis) of the upper two cervical nerves. He regards trauma to the neck as an important causative factor, and points out that in most head injuries there is a concurrent injury of the intervertebral disks of the neck.

The roentgen examination of the cervical spine in migraine usually shows definite variation from the normal. For the most part, the changes appear to fall into two main categories. The first group shows apparent exaggeration of the lordotic cervical curve usually seen in the hereditary type of migraine; the second displays a loss of the normal lordotic curve varying from slight deviation to complete reversal of the curve, usually found in the traumatic type. In addition

there may be changes typical of disk herniation. In some 25 per cent of the cases no apparent roentgenologic changes can be found. While the illustrations reproduced in the paper are rather poor, they do bring out rather marked changes at the level of C-5 and C-6.

The criteria usually considered necessary for a diagnosis of migraine are: (1) cephalalgia (usually hemicrania); (2) periodicity of attacks; (3) gastro-intestinal symptoms; (4) so-called cortical or psychic disturbances such as scotoma, paresthesias, etc.; (5) relief of attacks by gynergen or allied drugs. Twenty cases meeting the first two of these criteria and at least two of the remaining three were selected for treatment by head-traction manipulation and intramuscular injections of thiamin chloride. The results, based upon the patients' own estimates, are said to have shown an improvement of 70 to 100 per cent in all cases; 6 patients were free from attacks from six to twelve months following cessation of therapy. [It is unlikely that the author's enthusiasm for this mode of treatment will be shared by all who read this review.]

Five roentgenograms. S. F. THOMAS, M.D.
Palo Alto, Calif.

Rapid Serial Angiography: Preliminary Report. J. B. Curtis. J. Neurol., Neurosurg. & Psychiat. **12:** 167–181, August 1949.

A method of rapid serial angiography which will take 25 full-size x-ray pictures at intervals of one-half, two-thirds, or one second is described. The results in the normal and in a case of angiomatous malformation are demonstrated.

Thirty-five angiograms.

Percutaneous Carotid Angiography: A Team Technique, with a Report of the Results in Seventy Cases. M. Wilkinson, J. B. Stanton, D. P. Jones, and J. M. K. Spalding. J. Neurol., Neurosurg. & Psychiat. **12:** 183–186, August 1949.

A simple technic of percutaneous carotid angiography for a team of three, assisted by a nurse and technician, is described. The procedure was carried out in 68 patients (70 angiograms) whose ages ranged from nine to seventy-two years. Filling of the cerebral vessels was obtained in 66 cases. In 50 cases both lateral and anteroposterior views were good, and in 16 cases the lateral views were satisfactory but no anteroposterior views were taken. In some cases this was because the diagnosis could be made from the lateral views alone, but in the early cases adequate x-ray apparatus was not available for taking good quality anteroposterior angiograms. In 13 cases more than one attempt was necessary before satisfactory angiograms could be obtained. In only 4 cases was the examination completely unsuccessful, and in 3 of these only one attempt could be made.

Complications encountered in the series were: hematoma lasting three to seven days, 2 cases; cervical sympathetic paralysis lasting four weeks, 1 case; urticaria, 1 case.

Paraldehyde was used for premedication, as it was found that some sedation was desirable. General anesthesia, in the authors' opinion, is unnecessary in most cases and may even be an added risk.

Uriodone was used as the contrast material in all cases, in concentrations up to 70 per cent, but it has been found that good angiograms can be obtained with a 35 per cent solution for lateral views and 42.5 per cent solution for anteroposterior views. As a rule, the internal carotid should be punctured, since better contrast is then obtained with a smaller volume of Uriodone. If, however, it is desired to fill branches of the external carotid, as in a case of suspected meningioma, injection into the common carotid, low in the neck, is indicated.

Four angiograms; 1 photograph.

Cerebral Angiography: A Preliminary Report. Ramon Paterno, in collaboration with Jose Jose, Domingo Fernandez, and Augusto Besa. J. Philippine M. A. **25:** 375–384, August 1949.

This article describes an initial attempt at cerebral angiography in the Philippines and briefly reviews the literature. Illustrative cases are shown.

A simple cassette changer of home construction is employed. This "has the form of a long table on which the patient lies and inside which five loaded cassettes can be placed end to end under the patient's body. Four of the cassettes are protected by a lead sheet, while the fifth lies ready for exposure under the patient's head. The table is provided with metallic 'canals' or 'runners' on both sides, which permit the cassettes to be drawn smoothly and swiftly toward the head end of the table by means of a cord."

Four roentgenograms; 1 photograph.

A Simple Radiological Aid to Gasserian Injection. John Penman. Lancet **2:** 268–274, Aug. 13, 1949.

The author describes a radiological method of demonstrating the position of the needle in alcohol injection of the gasserian ganglion. Two simple projections with no screening quickly locate the needle point in all three dimensions of space and in exact relation to the foramen ovale.

An analysis of 135 consecutive attempted injections is made; 66 were unaided by radiology and compared with 57 aided by it. The results with radiology are decidedly better, though the method is not offered as a substitute for traditional skill and care.

For details of the technic, the original paper should be consulted.

Eight illustrations, including 2 roentgenograms; 2 tables.

Giant Pharyngoesophageal Diverticulum. Case Report. Robert A. Mino, Arthur I. Murphy, Jr., and Robert G. Livingstone. Surgery **26:** 237–241, August 1949.

The authors report the case of a 52-year-old Negro with a huge pharyngo-esophageal diverticulum producing a complete dysphagia with a known weight loss of 36 pounds in about five weeks. Roentgenographically the diverticulum was demonstrable as an oval mass in the mediastinum and right upper chest. Its superior and inferior poles were opposite the first and sixth thoracic vertebrae respectively, while the lateral border was about 9 cm. from the midline of the chest, encroaching on the pleural cavity and compressing the right lung. A definite fluid level was apparent. Barium did not pass from the cavity into the distal part of the esophagus. No change in the shape or size of the mass was observed during forceful exhalations with the epiglottis closed, and it did not collapse when it had been emptied by lavage. A Levin tube could not be passed beyond the diverticulum.

Emergency jejunostomy was performed and the patient gained 26 pounds in three weeks, after which operation was undertaken. The authors favor a two-stage procedure in order to permit the many fascial planes invaded in the course of dissection to seal themselves before removal of the diverticulum is completed. They found intermittent air injection through the lavage tube very helpful in mobilization of the sac for dissection. The only postoperative complication was a small abscess in the mediastinal defect, which was incised and drained. A follow-up roentgenogram at nine months revealed a normal pharynx and esophagus.

Five roentgenograms.

CHARLES C. WHITSETT, M.D.
Cleveland Clinic Foundation

THE CHEST

Cleft Left Upper Lobes and the Split Anterior Bronchus. Edward A. Boyden. Surgery **26:** 167–180, August 1949.

The author studied 100 upper lobes of the left lung. Eight per cent exhibited a deep cleft, with formation of a "middle lobe." This so-called "middle lobe" of the left lung, while usually corresponding to the middle lobe of the right lung, is not a consistent structure, but varies considerably in its bronchial content. Four categories are described: (1) true middle (or lingular) lobe, (2) compressed middle lobe, (3) expanded middle lobe, (4) the ectopic arterial type, the result of an ectopic left pulmonary artery. This last provides a fourth example of abnormal fissures that arise in association with displaced blood vessels, the others being the azygos vein, an abnormal ramus of the thoracic aorta, and the subclavian artery.

The varying anatomical limits of the upper lobe segments are described, particularly the anterior segment. The inferior limit of the anterior segment is placed at the first cardiac notch in 55 per cent of the 100 specimens, the superior limit at the apical-anterior notch in 56 per cent.

The prevailing pattern of the upper lobe bronchus was found to be bifurcate in 73 per cent of the 100 cases, subdividing into a superior and an inferior (or lingular) division. A trifurcate pattern exists in the remainder. The anterior segment may spread upward or downward as a result of (1) "splitting" of the anterior bronchus, that is, two bronchial buds arising from different sites embryonically, or (2) the downward displacement of the anterior ramus of the apical bronchus. When it becomes an accessory anterior bronchus (33 per cent), originating on the anterior bronchus proper (11 per cent), it expands the size of the anterior segment. This is clinically significant, as it provides a bronchial pathway by which an apical disease process may involve a major portion of the left upper lobe.

Other supplementary observations are made and illustrated. Of special interest are those on the inferior limit of the left upper lobe. In 56 per cent the medial end of the lobe was attached to the upper end of the pulmonary ligament in the vicinity of the inferior pulmonary vein. In a significant number of specimens, the medial end extended half-way from this point to the diaphragm, or even as far as the diaphragm itself (24 per cent).

Fifteen drawings; 2 tables.

LOUIS J. MAKIELSKI, M.D.
Cleveland Clinic Foundation

Simple Tests of Ventilatory Function for Use in the Sanatorium or Clinic. Frederick C. Warring, Jr. Am. Rev. Tuberc. **60:** 149–167, August 1949.

The author describes his method of testing ventilatory function in patients with pulmonary disease (tuberculosis) in a sanatorium. The apparatus consists of a 100-liter Douglas bag, a high-velocity one-way valve, connecting hose and couplings, noseclip, a converted gas meter, and a stopwatch. The walking ventilation and maximum breathing capacity are determined and the ratio of the former to the latter is determined. When the ratio is below 0.35, dyspnea is not present, above 0.50 it is severe. Chest fluoroscopy is done and an effort is made to determine the relative part of the total ventilation carried on by each lung; rib and diaphragm motion are observed during slow and rapid respiratory efforts. When the above tests are completed they are used in determining the probable tolerance of the patient to such therapeutic measures as thoracoplasty, pulmonary resection, pneumothorax, phrenic paralysis, and pneumoperitoneum.

The walking ventilation remains remarkably constant following the various procedures and during the course of the disease, but the maximum breathing capacity varies with the disease and changes following the procedures mentioned. Of a total of 123 patients studied, it was predicted that all could tolerate operation and would not be severely dyspneic when walking after operation. The prediction was incorrect in only two patients: one died of respiratory failure and the other became a respiratory cripple.

The author feels that, because of the relative simplicity of the methods used as compared to the complexity of such methods as differential bronchospirometry, they lend themselves to use in a number of clinics where the more complex methods are too costly and time-consuming.

Seventeen roentgenograms; 3 photographs; 2 tables.

J. H. JUHL, M.D.
University of Wisconsin

Arteriovenous Communications in the Lungs: New Method of Study. R. Bello de Moraes and Sérgio de Carvalho. Gaz. méd. Portuguesa **2:** 553–562, 1949. (In Portuguese)

The authors describe a study of the arteriovenous anastomoses in the lung by the use of radioactive tracers and radioautography. When a radioactive tracer and trypan blue were introduced into the left auricle following section of the pulmonary artery, both the tracer and the dye could be detected in the blood flowing from the sectioned artery. By the radioautographic technic the tracer could be located in the small vessels and in arteriovenous anastomoses of the type described by v. Hayek. With the pulmonary artery intact, the tracer was found only in the capillaries. After sectioning of the artery, it is believed that the arteriovenous communications, normally closed, open, permitting the blood to flow through these channels and reach the artery.

Fourteen illustrations, including autoradiographs and photomicrographs.

Congenital Obstructions of the Respiratory Tract. I. Tracheal Malformations. William A. Evans, Jr. Am. J. Roentgenol. **62:** 167–176, August 1949.

Two cases of congenital tracheal stenosis with necropsy findings are reported to illustrate the role of in-

trinsic factors in respiratory obstruction in infancy. In both, anomalous tracheal cartilaginous rings were present. While a review of the literature indicates that congenital stenosis of the trachea, usually with some malformation of the tracheal cartilages, is of rare occurrence, both the cases reported here were seen within a year, and three more cases, without pathological proof, have been encountered in the same institution (Children's Hospital of Michigan).

It is usually possible to obtain a satisfactory visualization of the air passages in the pharynx and trachea in lateral roentgenograms of the infant chest, but the single observation of a narrow trachea is not sufficient evidence for a diagnosis of congenital stenosis. Transient narrowing, presumably due to the softness of the tracheal cartilages in infancy, has been observed. Tracheal stenosis may also be produced by abnormal cervical and mediastinal masses, as an enlarged thymus, and by anomalous vascular rings, these external factors acting in conjunction with the pliability of the tracheal cartilages.

Actual atresia of the trachea is extremely rare and, of course, incompatible with life.

Nineteen roentgenograms; photographs of autopsy specimens.

JOHN W. WILSON, M.D.
Indiana University

Congenital Obstructions of the Respiratory Tract. II. Bronchial Malformations. William A. Evans, Jr. Am. J. Roentgenol. **62:** 177–184, August 1949.

Bronchial atresia is more commonly encountered than tracheal atresia (see preceding abstract). When the former anomaly exists, the corresponding lung segment is aplastic or hypoplastic. When uncomplicated by other congenital abnormalities, the condition may be asymptomatic and compatible with long life.

Two cases of bronchial stenosis due to congenital defects are reported. In one, deficiency of cartilage in the bronchial wall caused collapse of the bronchus and atelectasis of the lung, while in the other the obstruction was due to three cysts at the bifurcation of the trachea, apparently arising from the bronchial walls where there were defects in the cartilaginous rings of both main bronchi. Cases of bronchial obstruction due to congenital webs occluding the lumen are cited from the literature (Wallace: Arch. Path. **39:** 47, 1945).

The author also presents three cases of congenital expansile cysts of the lung treated surgically. Congenital cystic disease of the lung may take the form of a single cyst, a cystic lobe, or a cystic lung. Expansile cysts must be differentiated from diaphragmatic hernia, pneumothorax, agenesis and atelectasis in the opposite lung, emphysema, cystic areas acquired in the course of pneumonia, and occasionally from the picture seen in a slowly resolving atelectasis or inflammatory consolidation and in bronchiectasis. Surgical removal of the cyst, the cystic lobe, or cystic lung is indicated when the expanding segment threatens to impair the function of the remaining lung.

Nine roentgenograms; 3 photographs.

JOHN W. WILSON, M.D.
Indiana University

Lipiodol Bronchography from the Radiologic Point of View. M. Brombart. J. belge de radiol. **32:** 79–89, 1949. (In French)

The radiologist should be alert to suggest bronchography upon finding certain conditions in his routine daily work. Suspicion of bronchogenic carcinoma and of bronchiectasis is of paramount importance, but there are other less spectacular diseases which offer fruitful fields for bronchographic investigation. Bronchitis in all its stages, from endobronchitis to cylindrical dilatations, segmental bronchitis, generalized or localized emphysema, asthma, and partial or generalized fibrosis are among the neglected conditions which may be studied more carefully by bronchography. A discussion is given concerning combined fluoroscopic and film study of bronchial morphology and dynamics. Study of the patient in various positions and in various phases of respiration aids in more complete filling of the bronchi, in demonstrating cavities, and in revealing bronchospasm.

Thirty-eight roentgenograms.

CHAS. NICE, M.D.
University of Minnesota

Bronchial Lipiodol in Pulmonary Emphysema. P.-L. Drouet, R. Herbeuval, and G. Faivre. J. franç. méd. et chir. thorac. **3:** 201–210, 1949. (In French)

The diagnosis of pulmonary emphysema is made so frequently that some doubt may be cast upon its accuracy. It is evident that the mere signs and symptoms of chronic dyspnea and lack of excursion of the ribs during respiration do not suffice to justify the diagnosis. Autopsy findings often disprove the clinical impression. The chest roentgenogram is of tremendous value but additional help can be provided by bronchography, which reveals characteristic broncho-alveolar changes.

Films should be obtained immediately after injection, followed by films five, twenty, and forty-five minutes later, and lastly by a six- to eight-hour film. This technic permits a study of the transit time of the opaque oil from the bronchus to the bronchiole and from the bronchiole to the alveolus. Under fluoroscopic visualization, the bronchi in emphysema appear narrower than usual and are spread apart from each other. On the twenty-minute film a rather characteristic image appears; the second and third division bronchi show no collateral branches, and the trunk continues its course toward the periphery. In addition, numerous "amputations" of bronchial trunks appear: there is a definite lag in the transit of the oil toward the alveoli. One would expect pooling and puddling of the oil in the alveoli because of the rupture of alveolar walls always present in emphysema, but this seldom occurs. The free air spaces usually are not filled, and often an image of a bronchial trunk ends abruptly, to be capped by a rounded translucent bleb.

The typical picture in emphysema is lack of alveolar filling even under the influence of vigorous coughing. In the rare cases where alveolar filling occurs there is flooding of large lakes instead of the lacy leaf-like image of the normal alveolus. The last film shows complete evacuation of the opaque oil from the lungs.

The studies suggest a peripheral bronchiolar obstruction as the cause of ordinary emphysema, whatever the nature of this obstruction may be. The alveolar air remains trapped and cannot escape. Normally filling of the alveoli with oil occurs at any time within seventy-two hours, but in the presence of emphysema all the oil is coughed up in six to eight hours.

Eight roentgenograms.

E. M. SAVIGNAC, M.D.
Detroit, Mich.

Bronchography in the Severely Discharging Lung. James E. Lett and M. Wendell Dietz. Bull. Johns Hopkins Hosp. **85:** 135–137, August 1949.

Adequate bronchography in the bronchiectatic patient with a copious pulmonary discharge poses a complex problem. The authors have found a new thin-walled, plastic endotracheal tube to be the solution. It softens in warm water; on cooling it assumes a semi-rigid nature, elastic enough to prevent trauma. After anesthetization of the upper air passages, including the nares and nasopharynx, the tube is passed under mirror vision into the upper trachea, well above the carina. Both sides of the bronchial tree are aspirated by a long catheter or small-caliber plastic tubing through the lumen of the endotracheal tube. In cases in which the secretions are tenacious, flushing with small quantities of saline solution may be necessary. After removal of the pus, the lower tree is anesthetized by dilute pontocaine instillation.

If the endotracheal tube is left in place, the oil catheter can be easily introduced through it into the tree. By not removing the tube until after the roentgenologic examination is completed, coughing is reduced and working in the darkened fluoroscopic room is facilitated. All of the cases studied by the authors were subjected to bronchoscopy twenty-four hours prior to bronchography for removal of collected discharge; postural drainage was instituted after this procedure.

By this method it was possible to demonstrate bronchiectasis in all 5 lobes and lingula at one bronchographic examination in a 64-year-old woman whose sputum was in excess of 800 c.c. per day. In other cases it has shown the status of the bronchial tree after other technics failed.

Two bronchograms.

Lipoid Granuloma of the Lung Following Bronchography with Iodized Oil. Richard P. Storrs, John R. McDonald, and C. Allen Good. J. Thoracic Surg. **18:** 561–568, August 1949.

A case is reported in which a granulomatous process was found in the lung three weeks after bronchography with iodized and chlorinated peanut oil (iodochlorol). A lobectomy was done for bronchiectasis, and the resected lobe contained a number of solid yellowish gray areas 1.0 mm. to 1.5 cm. in diameter, occupying about a sixth of the lower lobe peripherally. The larger nodules fused with one another. A roentgenogram of the specimen showed a considerable amount of radiopaque material at these sites. Special stains indicated the presence of an oil, and the iodine content of these areas was found on chemical analysis to be 300 times more than elsewhere in the lung. Microscopically they were granulomatous processes made up of tubercle-like structures containing oil globules and in some areas showing necrosis.

There have been 3 similar cases reported in the literature, 2 following the use of lipiodol and one after iodized sesame oil. Iodochlorol has been used by the authors for six or seven years without ill effect in any other instance. They believe that the complication must be a rare one, resembling the reaction seen when animal oils of high fatty acid content are present in the lungs. They advise that an attempt be made to remove all the oil from the lungs after bronchography. Also, they advise delaying surgery until most of the oil has disappeared from the lungs as determined by preoperative films. This precaution is prompted by the fact that this patient exhibited an apparent reduction in pulmonary reserve requiring oxygen therapy for a long period postoperatively.

Ten illustrations, including 4 roentgenograms.

HAROLD O. PETERSON, M.D.
University of Minnesota

Physiological Significance of Bronchiectasis. Duane Carr, Edward F. Skinner, Wm. E. Denman, and Chas. R. Kessler. Dis. of Chest **16:** 137–142, August 1949.

While pathological enlargement of one or more bronchi or bronchioles is the characteristic feature of bronchiectasis, it is not the fundamental factor but is only the demonstrable effect of an underlying pathological process which interferes with bronchial function. Cicatricial tissue or squamous epithelium replaces the normal columnar ciliated epithelium; the basement membrane of the mucosa is damaged or destroyed; elastic fibers disappear; the submucosa becomes fibrotic and rigid, and fibrosis occurs also about the bronchi in the lung parenchyma. The rigidity of the bronchial walls prevents bronchial peristalsis, while the associated atelectasis, pneumonitis, or sclerosis of the surrounding lung prevents the admission of air which would aid in the expulsion of mucus, pus, or a foreign body through the medium of coughing. The condition is progressive, as retention of the products of infection causes increasing fibrosis and rigidity and these in turn interfere still further with the cough reflex.

The authors discuss briefly the diagnosis and treatment of bronchiectasis, with especial emphasis upon bronchography. They have found the "dribble" method, as effective as any of the more complicated procedures. The patient is seated and 0.5 per cent pontocaine is introduced by "dribbling" it through one nostril and tilting the patient first to the right and then to the left to insure good distribution. Immediately following this, the warmed iodized oil is slowly instilled in the same fashion. When fluoroscopy shows that the desired bronchi have been well filled, appropriate x-ray films are immediately made.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Bronchiectasis: A Study of the Segmental Distribution of the Pathologic Lesions. J. R. Moore, S. D. Kobernick, and F. W. Wiglesworth. Surg., Gynec. & Obst. **89:** 145–153, August 1949.

In 7 cases of relatively early bronchiectasis in children for which lobectomy had been performed, the resected tissue was dissected segmentally. The distribution of the lesions, as seen roentgenographically, is compared with the gross and microscopic findings. It was found that definite though minimal inflammatory lesions were present in segments which had appeared unaffected on bronchographic and gross examination.

Thirteen photomicrographs; 2 tables.

JOHN F. GIBBONS, M.D.
University of Pennsylvania

Chronic Bilateral Basal Pulmonary Fibrosis. Ben E. Goodrich and Thomas D. Johnson. Dis. of Chest **16:** 184–189, August 1949.

Chronic basal pulmonary fibrosis may result from a variety of causes; in some the etiology can be determined, in others it cannot. The authors studied 99 cases, and in 18 no specific diagnosis was established.

Fibrocystic proliferation and replacement can occur with failure of the self-cleansing mechanism of the lung, whether the substance retained is congestive or infectious in nature, metabolic in origin, or derived from inhaled particles. Possible causes, excluding tuberculosis, silicosis, and upper respiratory infections, are bronchiectasis, obliterative broncholitis associated with uremia, virus infection, chronic passive congestion, emphysema, long standing asthma, cystic disease of the pancreas in children, and radiation reactions. The x-ray findings may be simulated by metastatic lymphangitis, inhalation diseases, Boeck's sarcoid, primary pulmonary arteriosclerosis, lipoid reticulo-endotheliosis and leukemic infiltrations.

Four illustrative cases are reported.

In the discussion following the paper, Robert Bloch stated that the x-ray examination is unexcelled in demonstrating the presence of pathology, but the differential diagnosis must be made by other means. He advised care in the use of the word "fibrosis," since many lesions which are not fibrotic simulate fibrosis. A. Carlton Ernestene stressed the necessity of investigating unilateral lesions by bronchoscopic means rather than roentgenographic observation alone, because of the time factor should surgery be indicated. Edwin R. Levine suggested that many of these basal fibroses are the result of our erect stature, due to lack of drainage, residual bronchial infection, and atelectasis.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Diffuse Interstitial Fibrosis of the Lungs. Alfred Golden and I. Frank Tullis, Jr. Mil. Surgeon **105:** 130–137, August 1949.

Two fatal cases of diffuse, bilateral interstitial fibrosis of the lungs, with clinical and pathological features similar to those described by Hamman and Rich (Bull. Johns Hopkins Hosp. **74:** 177, 1944. Abst. in Radiology **43:** 405, 1944) are reported. The view is expressed that such interstitial fibrosis may be on the basis of failure of resolution and subsequent organization following one or more attacks of acute interstitial pneumonitis ("primary atypical pneumonia").

Five illustrations, including 1 roentgenogram.

Intrabronchial Lipiodol in the Images Called "Fibrosis of the Right Base." Peromet. J. belge de radiol. **32:** 90–97, 1949. (In French)

A great number of the linear opacities seen at the right base in chest roentgenograms which are described as peribronchial fibrosis or accentuation of vascular shadows are in reality due to partial or total atelectasis of the right middle lobe. Lipiodol bronchography aids in demonstrating endobronchial inflammatory changes which often cause this picture.

In 1931, Van Allen and Jung (J. Thoracic Surg. **1:** 3, 1931. Abst. in Radiology **18:** 837, 1932) demonstrated experimentally, in the dog, the existence of collateral ventilation. They found that when a segmental bronchus was involved by pathological obstruction, ventilation was supplied by collateral channels from adjoining segments of the same lobe. This mechanism is apparently not so effective in the right middle lobe. Also, this collateral ventilation is not effective when respiration becomes shallow, as after surgery, in shock, and in paralysis of the respiratory muscles.

Twelve roentgenograms. CHAS. NICE, M.D.
University of Minnesota

Pulmonary Syphilis. Presentation of a Case. R. Benda, F. Franchel, and G. Lécuyer. J. franç. méd. et chir. thorac. **3:** 238–241, 1949. (In French)

A white male, aged 53, gave a history of a persistent dry cough without malaise, of long duration. A chest film in 1943 had shown a pneumonitis in the right middle lobe and thickening of markings in the right cardiophrenic angle. In January 1947 there had been a sudden hemoptysis without fever. A film at that time revealed irregular opacities in the lower two-thirds of the right lung. The sputum was negative for tubercle bacilli. Bronchoscopy in July 1947 was followed by another hemoptysis; the only findings were a mild mucosal roughening of the right upper lobe bronchus of non-specific inflammatory character.

A film of the chest obtained by the authors was similar to that of 1947. Bronchograms revealed no changes in the bronchial tree. Laminagrams showed a wide, coarse, reticular pattern of sclerocystic aspect, suggesting a peribronchial and perilobular involvement. All serologic tests for syphilis were strongly positive. The patient then told of a chancre in 1915, treated by only four injections of an arsenical compound. Following fifteen daily intravenous injections of mercuric cyanide, a very marked improvement in the roentgenologic appearance of the right lung occurred. In September 1948 only a mild thickening of lung markings was demonstrable roentgenologically and the patient was symptom-free.

The authors place great importance on the wide, coarse, network pattern revealed by the laminagram as being one of the frequent manifestations of pulmonary syphilis. The influence of antisyphilitic therapy upon the persistent chronic lung disorder in this case added further evidence in favor of the diagnosis.

Two roentgenograms. E. M. SAVIGNAC, M.D.
Detroit, Mich.

Sarcoidosis. A Clinicopathologic Review of Three Hundred Cases, Including Twenty-Two Autopsies. Walter Ricker and Mardelle Clark. Am. J. Clin. Path. **19:** 725–749, August 1949.

From the files of the Army Institute of Pathology 300 consecutive cases of sarcoidosis were analyzed.

The review of the clinical features showed the following:

1. The disease reached peak occurrence in the 20 to 24-year age group.

2. The disease occurred seventeen times as often among Negro men as among white men in the Army.

3. Of the 258 patients who presented symptoms on admission to the hospital, the most common were: enlarged lymph nodes (86 per cent); cough (20 per cent); weight loss (19 per cent); skin manifestations (16 per cent); low-grade fever (15 per cent); malaise (10 per cent); weakness (10 per cent).

4. In the entire group of 300 patients, the organs most frequently affected were: lymph nodes (83 per cent); skin (21 per cent); bone (17 per cent); eyes and liver (each 9 per cent); spleen (8 per cent).

5. Over two-thirds of the patients were admitted to hospitals within six months after they first noticed symptoms.

6. Roentgen examination showed mediastinal widening in 76 per cent of the 153 patients examined, while small-bone involvement was seen in 36 per cent of the 94 patients who had roentgen examination of the extremities.

7. Tuberculin skin tests were negative in 97 per cent of 88 patients.

8. The sedimentation rate was elevated in 62 per cent of 52 patients.

9. Hyperproteinemia of 8 gm. or more per 100 ml. of blood was present in one-third of 40 patients.

Twenty-two autopsied cases of sarcoidosis are added to 62 collected from the literature. Sarcoidosis was unsuspected until autopsy in 14 of the present series, and in only 3 was death unequivocally due to sarcoidosis. Three of the 22 patients had associated sarcoidosis and tuberculosis and an additional 2 of the 22 showed abacterial caseating lesions of the adrenal glands with clinical Addison's disease.

Ten photomicrographs; 3 charts; 6 tables.

Correlation of Clinical and Radiologic Findings in Besnier-Boeck-Schaumann Disease. P. Wellens and J. Bayens. J. belge de radiol. **32:** 14–30, 1949. (In French)

The clinical as well as the radiologic features of Boeck's sarcoid are brought out in this article in order to familiarize radiologists with the varied and often puzzling manifestations of the disease. Thus they may be able to direct their diagnostic interpretations in the proper direction and also give conclusive proof whenever the disease is suspected. Certainly none of the radiologic features are pathognomonic, and a thorough acquaintance with the clinical picture is essential.

The etiology of sarcoidosis still remains obscure, especially in its relation to tuberculosis. The prevailing view at present, the authors state, is that sarcoidosis is a special form of tuberculosis, conditioned by a peculiar allergic state. However, the facts remain that tubercle bacilli have never been recovered from sarcoid lesions, nor could they be found following inoculations of pathologic material from sarcoidosis; furthermore the percentage of positive tuberculin tests in sarcoid patients is not in excess of the expected ratio in the population as a whole. Yet the literature abounds with cases considered as sarcoidosis which have ultimately evolved into proved tuberculosis.

Histologically the nodules of sarcoidosis are tubercles which present a scanty lymphocytic infiltration, very few Langhans cells, and no discoverable Koch bacilli. Only very rarely do they show caseation, calcification, or cavity formation.

Clinically, the patient's general health remains good, with occasionally a mild weight loss; generally there is a marked contrast between this state of well-being and the alarming findings in the chest roentgenogram. There is little or no fever. The white blood count usually remains normal and there is no change in the sedimentation rate. Sternal puncture has also yielded a normal hemogram. The levels of blood phosphatase, calcium, total protein, globulin, and fibrinogen are usually elevated. The localization of the disease may be single or multiple, but no patient ever shows involvement in all the possible locations. In their order of frequency the sites are the lymph nodes, skin, bones, spleen, liver, eyes, parotid glands, mucosa of the respiratory tract, lacrimal glands, serous membranes, nervous system, gastro-intestinal tract.

Practically always lesions are found in the reticuloendothelial system, and especially in its lymphatic components. This explains the frequent discovery of the disease in roentgenograms of the chest, since the pulmonary and mediastinal tissues abound in lymphatics. Usually the hilar, mediastinal and pulmonary nodes are first involved. The adenopathy may take any form, single or multiple, discrete or confluent, large or small, but as a rule shows no calcifications. When the lungs become involved, three types of images may be found: (1) a miliary or micronodular image due to the presence of numerous small nodules, particularly in the mid and superior zones of the lungs and the perihilar areas; (2) a reticular or bronchopulmonary image characterized by diffuse perivascular and peribronchial infiltrates fanning out from the hilus to the periphery; (3) a mottled image produced by more or less definitely circumscribed discrete infiltrates—a sort of exaggerated reticular pattern. All varieties of these images appearing alone or together, with or without adenopathies, may be encountered. There may also be a complicating pleural or pericardial effusion.

To be chiefly considered in the differential diagnosis of the hilar type of involvement is Hodgkin's disease and frequently the differentiation can be arrived at only by repeated roentgen studies. Sarcoidosis regresses slowly and spontaneously, while Hodgkin's disease progresses, as does lymphosarcoma. Also to be considered, and difficult to exclude, are tuberculous adenopathy and an early bronchogenic carcinoma. The miliary form of sarcoidosis must be distinguished particularly from miliary tuberculosis, miliary carcinomatosis, first and second grade silicosis, and pulmonary stasis of cardiac decompensation. With a reticular or mottled image, one must rule out neoplastic metastases, diffuse pulmonary fibrosis, certain forms of chronic bronchopneumonia, and interstitial pulmonary syphilis.

In the gastro-intestinal tract sarcoid lesions have been described producing gastric ulcers and ileitis.

Sarcoidosis of the lacrimo-salivary apparatus produces two main syndromes; (1) Heerfordt's syndrome, characterized by swelling of the parotid glands, iridocyclitis, and facial paralysis; (2) Mikulicz's syndrome, with swelling of all the salivary glands and of the lacrimal glands without iridocyclitis or facial palsy.

The bone lesions occur usually in the fingers and toes, less frequently in the metacarpals and metatarsals and rarely in the carpals or tarsals. Several types of involvement are described, apparently corresponding to stages of evolution of the disease but seen also in mixed forms. They are as follows:

(1) Diffuse involvement. It is impossible clearly to distinguish cortex from medulla; there is an appearance of diffuse bony rarefaction or a honeycombed aspect. The cortex is very thin and may show localized erosions. Only the proximal epiphyses show a normal spongiosa. There is no osteosclerosis.

(2) Circumscribed form. A spotty bone resorption produces round or oval lacunae, generally small, but of variable size, with sharp contours and without surrounding bony reaction. These lacunae are not bone cysts but represent small granulomata which replace the bony tissue. This form involves only the epiphyses and never the diaphyses.

(3) Mutilating form. After years of evolution, the small foci may coalesce producing bone destruction.

The differential diagnosis of the bone lesions must exclude tuberculosis, syphilis, and leprosy. Several features help in differentiation: sarcoidosis presents no osteosclerosis, no periosteal reaction, no sequestration, no epiphyseal changes or growth disturbances, and the diaphysis never expands to the degree seen in tuberculous dactylitis.

The cutaneous system reveals three main types of involvement; the miliary lupoids of Boeck, the large nodular sarcoids of Boeck, and Besnier's lupus pernio.

The nervous system shows facial palsy and other types of peripheral neuritis; involvement of the central nervous system has also been described, with increased intracranial pressure, epilepsy, and diabetes insipidus.

Twenty-four roentgenograms.

E. M. SAVIGNAC, M.D.
Detroit, Mich.

Recent Experimental Studies of Pulmonary Ascaridiasis. F. Cardis. J. franç. méd et chir. thorac. **3:** 230–238, 1949. (In French)

The view that parasites play an etiologic role in certain of the pneumonias is an ancient one. In 1841 the French clinician Grisolle dogmatically dismissed this theory but his opinion has since been reversed and parasitology has regained its place in the field of pulmonary pathology.

In an extremely interesting paper, written in a free, informal style that might well serve as a model for medical publications, Cardis discusses the relation of *Ascaris* to Loeffler's syndrome, citing numerous contributions for and against an etiologic relationship. Of particular interest are the experiments of Vogel and Minning, performed upon themselves and four collaborators, revealing the following facts as to Ascaris infestation.

(1) The radiologic and clinical manifestations appear, progress, and resolve between the sixteenth and the twentieth days following the ingestion of fertilized eggs; these manifestations generally last from three to eight days.

(2) Clinically there occurs a mild generalized malaise, a transitory low-grade fever, a little bit of coughing, a minimal degree of expectoration, which is yellowish, clear, and rich in eosinophils.

(3) The blood eosinophilia rises to 8 per cent and more, reaching 60 per cent in one case; its maximum occurs between the nineteenth and the twenty-first day after infestation; the eosinophilia therefore lags behind the radiologic findings in point of time. In addition, the blood studies reveal a slight granulocytosis and lymphopenia; the sedimentation rate is moderately accelerated.

(4) The Ascaris eggs never appear in the stool before the sixty-eighth day.

On the strength of these observations and other sources of information, the present writer showed in 1944 that ascaridiasis is undoubtedly the most frequent cause of transient pulmonary infiltration with eosinophilia and that the infiltrate is directly connected with the migration of the larvae into the lungs. Against the concept of an allergic reaction he cites the clinical constancy of the syndrome; its uniform and sometimes epidemic character; its identity when affecting the organism for the first or for the *n*th time (recurrences are frequent); the impossibility of reproducing the syndrome with any of the plant or bacterial allergens held responsible.

Loeffler, however, remained unconvinced and undertook further studies in collaboration with Essellier and Macedo—parasitologic, radiologic, hematologic, and histopathologic—of Ascaris infestation in the guinea-pig. The results of these studies are quoted as follows:

(1) Eosinophilic infiltrates are found in the mucosa of the terminal ileum and the cecum from the first to the fourth day after ingestion of Ascaris eggs. On one occasion the larvae were also identified in this infiltrate.

(2) Larvae are found in great numbers in the liver and are surrounded by eosinophilic infiltrates. They reach the liver in all probability *via* the blood stream and probably rarely by way of the lymphatics, since only occasionally a mild catarrhal inflammation of the sinus of lymph follicles was found, and larvae were never recovered from the lymphatic tissues.

(3) In the lungs of *all* the animals sacrificed from the first to the sixteenth day are found numerous eosinophilic foci in the parenchymatous, perivascular, and peribronchial tissues; larvae of Ascaris are seen in the infiltrates, in the bronchioles and smaller bronchi, which they sometimes obstruct to produce areas of atelectasis.

(4) Larvae were recovered nowhere else than in the cecum from the first to the sixth day, in the liver and lungs from the sixth to the sixteenth day; their abundance in the liver and lungs is in inverse ratio to the time following infestation. A guinea-pig killed on the thirty-fourth day showed no anatomic changes, like the control animals. It should be stated that Ascaris larvae do not mature into adult worms in the intestine of the guinea-pig; they die soon after reaching the gut.

(5) The radiologic study shows infiltrates in the basal and median portions of the lungs, but especially in the right lung in 75 per cent of the animals from the third to the eighth day, but even up to the thirteenth day.

(6) Blood eosinophilia was present in 64 per cent of the animals (in 77 per cent of the 9 guinea-pigs on their second infestation); the level of eosinophilia did not exceed 22 per cent; it disappeared in ten to fourteen days; its height was always later in development than the x-ray manifestations.

Therefore the cycle, parasitologic, radiologic, clinical, hematological and histopathological of the identity of Loeffler's syndrome and pulmonary ascaridiasis is closed.

This does not mean that Loeffler's syndrome is exclusively due to Ascaris, since other parasites have also been shown to be associated with a transient pulmonary infiltrate. Whether other than parasitic causes can produce the syndrome the author is hesitant to say. For the present he limits himself to the conclusion that the transient pulmonary infiltrate with blood eosinophilia is identical with experimental ascaridiasis in man and in animals and that several nematodes produce an analogous syndrome by migration of larvae through the lungs.

Unfortunately no references are given to the numerous papers cited. The contribution by Vogel and Minning is in Beitr. z. klin. d. Tuberk. **98:** 620, 1942. The present abstract was prepared from a translation by:

E. M. SAVIGNAC, M.D.
Detroit, Mich.

Nocardiosis. Pneumonia and Empyema due to Nocardia Asteroides. Herbert F. Hager, Anthony V. Migliaccio, and Raymond M. Young. New England J. Med. **241:** 226–231, Aug. 11, 1949.

This paper presents a review of the literature on infections due to *Nocardia* and a case. The patient was a 16-year-old girl with evidence of a pulmonary infection. A roentgenogram showed fluid collection in the right chest. Culture of the sputum revealed *Streptococcus viridans* but no acid-fast organisms. Treatment with penicillin met with some response, but the temperature continued to show irregular elevation, and sub-

sequently thoracentesis was done, yielding only sterile bloody fluid. Streptomycin was later administered and thoracentesis was again performed. This yielded a foul-smelling green fluid from which a culture of *N. asteroides* and gram-negative anaerobic fusiform bacteria were recovered. A rib resection with drainage was instituted. The patient received penicillin, streptomycin, and sulfadiazine, and made a good recovery.

A brief note on a second patient is included. This was a 64-year-old woman with a history of cough of long standing and chest films showing apical infiltrations. Culture of the sputum revealed *N. asteroides*, but apparently no therapy was administered.

The characteristics of *Nocardia asteroides* and related organisms are discussed, together with the infection as it appears in man. The combination of penicillin, streptomycin and sulfadiazine appears to be quite effective in treatment. It was noted, however, that only after drainage of the chest did the authors' patient begin to make a definite recovery.

Six illustrations, including 4 roentgenograms.

JOHN B. MCANENY, M.D.
Johnstown, Penna.

Pulmonary Hydatid Disease. The Sign of the Camalote. M. H. Fainsinger. South African M. J. **23:** 723, Aug. 27, 1949.

Report of a case of pulmonary hydatid cyst proved at autopsy. A tomogram is reproduced showing the ectocystic cavity, the crumpled endocyst, and the irregular draining bronchus from which the repeated hemoptyses took place.

Basal Tuberculosis Simulating Sub-Phrenic Abscess. Robert J. Gross and Franklin H. Schaefer. Dis. of Chest **16:** 193–196, August 1949.

The authors report the case of a 60-year-old man whose clinical course suggested a subdiaphragmatic abscess but who was found eventually to have a right lower lobe tuberculosis. The patient was originally operated upon because of intestinal obstruction. Ten days later a roentgenogram of the chest revealed congestive changes thought to be secondary to elevation of the diaphragm, and a small amount of air was demonstrable beneath the right leaf of the diaphragm, remaining from the operation. No infiltrating lesion was seen in the lung parenchyma. A second x-ray examination after about two months revealed an extensive pleural effusion and suggested the possibility of a subdiaphragmatic lesion. Serial films at intervals during the next three months showed persistent pleuropulmonary changes, and exploration was eventually undertaken, but no evidence of abscess in the subdiaphragmatic space was found. Four months later tubercle bacilli were recovered from a pleural tap.

Four roentgenograms. HENRY K. TAYLOR, M.D.
New York, N. Y.

Tuberculosis Control in Ohio State Reformatory. (1) With Comparative Study of Two Year Periods. (2) With Survey of Penal Institutions in the United States and Canada. (3) With Recommendations for More Complete Control Measures. Oren A. Beatty and John V. Horst. Dis. of Chest **16:** 225–233, August 1949.

In the August 1947 issue of the *Ohio State Medical Journal* (Abst. in Radiology **51:** 129, 1948) the authors described the tuberculosis control measures followed at Ohio State Reformatory. Since Jan. 1, 1944, all prisoners have had an x-ray examination of the chest on admission and re-examination whenever indicated. All patients with active tuberculosis have been isolated; collapse therapy has been employed when indicated.

During the two-year period, Jan. 1, 1946, to Jan. 1, 1948, routine x-ray examination of 2,424 commitments (1,678 white, 746 colored) revealed 52 cases of tuberculosis (33 white, 19 colored) of which 40 were considered active and 12 healed. In comparison with the previous two-year period, there was a definite drop in the number of cases of active tuberculosis, as well as in the number of cases of inactive tuberculosis, in both races, although the total number examined was about the same. The active cases in the white population dropped from 1.74 per cent to 1.67 per cent and in the colored population from 3.05 per cent to 1.74 per cent. The total rate dropped from 3.67 per cent to 2.1 per cent.

A survey of 78 penal institutions in the United States and Canada showed that only a few have a case-finding program that is continuously, day by day, searching for new cases of tuberculosis. No institution reported that routine x-ray examination of the chest was made of all admissions. Mass x-raying by the small-film technic was used in 17 institutions, more frequently in Federal than in State institutions. Forty-one institutions isolated their tuberculosis patients in a special ward in the general penal hospital. Twenty-six institutions had a special tuberculosis hospital. The Federal institutions all send their tuberculosis inmates to the Medical Center at Springfield, Mo.

The recommendations are similar to those listed in the previous report.

Erythema Nodosum. J. H. Middlemiss. Brit. J. Radiol. **22:** 375–383, July 1949.

An analysis of 124 cases of erythema nodosum is given, in patients varying in age from seventeen months to fifty-five years. Because of a positive Mantoux test and x-ray appearances consistent with the disease, 55 of the cases were regarded as definitely caused by tuberculosis. In 5 of these the diagnosis of tuberculosis was confirmed by biopsy and in 3 at necropsy; 4 patients had positive sputum. In 44 cases a positive Mantoux was the only evidence of tuberculosis. In 4 of the Mantoux-negative cases a positive throat culture of hemolytic streptococcus was obtained; 8 cases appeared after the administration of sulfonamides, and in 15 no definite etiological factor could be found. In 4 cases there was a history of one or more recurrences.

Eight roentgenograms; 4 tables.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Clinical and Roentgen Manifestations of Pneumonia Due to Bacillus Mucosus Capsulatus (Primary Friedländer Pneumonia). Max Ritvo and Francis Martin. Am. J. Roentgenol. **62:** 211–222, August 1949.

This is an excellent review of Friedländer pneumonia with an extensive bibliography and five case histories. The high mortality (70–80 per cent) of this type of pneumonia makes early diagnosis imperative, so that streptomycin can be administered in the acute phase. The disease should be suspected in individuals over forty, usually male, with sudden onset of symptoms of pneumonia and only a slight leukocytosis.

Roentgenologically three forms are seen: (1) massive lobar consolidation which may be confused with neoplasm and fluid; (2) lobular consolidation in one or more lobes; (3) a chronic form characterized by lung abscess formation and pulmonary suppuration, somewhat simulating tuberculosis.

Twelve roentgenograms. M. M. MANALAN, M.D.
Indiana University

Pulmonary Adenomatosis. Report of a Case. Benjamin Freedman. Am. Rev. Tuberc. **60:** 258–263, August 1949.

A case of pulmonary adenomatosis is reported in a 29-year-old woman who succumbed to the disease approximately fifteen months after the onset of symptoms. Cough with production of thin watery sputum and chest pain were early symptoms; dyspnea and weight loss followed. Several acute respiratory episodes which were thought to be pneumonia occurred during the course of the disease. The initial roentgenogram of the chest showed consolidation at the right base with some localized nodular areas of increased density in the left mid-lung field. Tubercle bacilli were found in the sputum on two widely separated occasions and the patient was treated with streptomycin and pneumoperitoneum without much alteration in the course.

The roentgenographic picture was one of slow progression, with eventual conglomeration of the nodules on the left to involve the central half of the lung and with almost complete consolidation on the right.

The diagnosis was made at autopsy, when the disease was found to involve both lungs and the hilar nodes. The tumor cells were columnar in type. Masses of these cells formed papillary projections which filled alveoli and obliterated the normal architecture in some areas. A large amount of fibrous tissue supported the tumor cells in other areas.

The origin of the tumor cells is discussed briefly. Although admitting that the site is still controversial, the author seems inclined to feel that the neoplasm arises from the terminal bronchiolar epithelium.

Four roentgenograms; 2 photographs; 2 photomicrographs. J. H. JUHL, M.D.
University of Wisconsin

Premature Calcification of the Costal Cartilages: Its Frequent Association with Symptoms of Non-Organic Origin. John L. Horner. Am. J. M. Sc. **218:** 186–193, August 1949.

Calcification of the costal cartilages is a process which, while presumed to be a matter of aging, is frequently found in young persons. It is generally held to be of no consequence, but this view the author considers illogical. Numerous causes and factors associated with it have been postulated but no satisfactory explanation has been offered.

A study of 277 office patients under the age of forty years, unselected except for the fact that the lower rib area was adequately demonstrable, showed 158 with roentgen evidence of costal cartilage calcification and 119 without. Significant differences between those persons who showed calcium in the costal cartilages and those who did not were found in the number of complaints, the history of menstrual disorders in the women, the percentage with obesity, and the final chief diagnosis. In the former group there were twice the number of complaints, twice the incidence of obesity, and three times the incidence of menstrual disorders (women alone considered). Most interesting was the fact that complaints apparently not due to organic disease—diagnosed as "psychoneurosis" or "indeterminate"—were five times as frequent in the calcification group. The author suggests the possibility that in such cases the psychoneurosis and the deposit of calcium are on the basis of a long-standing endocrine disturbance.

One roentgenogram; 2 charts; 2 tables.
SHOZO IBA, M.D.
Cleveland City Hospital

Bronchogenic Cysts of the Mediastinum. L. Martin Hardy. Pediatrics **4:** 108–113, July 1949.

Many mediastinal tumors are congenital in origin and have a definite tendency toward malignant change. With the comparative safety of present-day thoracic surgery, it is the author's feeling that demonstrable tumors should be removed. He briefly reviews the literature and reports the case of an 8-month-old child. Roentgenography revealed obstructive emphysema and suggested the presence of a mass causing pressure on the esophagus and left main bronchus. Satisfactory recovery followed removal of a large bronchogenic cyst.

These cysts are believed to be formed by the pinching off of a small bud or diverticulum of the foregut. They are frequently found in the posterior mediastinum or posterior portion of the superior mediastinum, usually near the bifurcation of the trachea, occasionally communicating with it or a bronchus; they may lie between the esophagus and trachea. Symptoms and signs are due to pressure on adjacent organs and to ensuing infection. Bronchoscopy and esophagoscopy rule out intrinsic lesions in these structures and corroborate the roentgenographic and fluoroscopic findings. In the absence of adhesions, induced pneumothorax reveals a mediastinal mass. Bronchogenic cysts are smooth, ovoid or round; dermoids are usually lobulated. In addition, dermoids frequently contain calcifications and are located in the anterior mediastinum. Neurogenic tumors frequently erode ribs. Malignant tumors cannot be definitely excluded by examination alone.

Five roentgenograms; 1 photomicrograph.
HARRY J. PERLBERG JR., M.D.
New York, N. Y.

Case of Aneurysm of the Ductus Arteriosus with Postmortem Roentgenologic Study After the Instillation of Barium Paste. John H. Kneidel. Am. J. Roentgenol. **62:** 223–228, August 1949.

Aneurysm of the ductus arteriosus is of relatively rare occurrence. Mackler and Graham (J. Thoracic Surg. **12:** 719, 1943) found only 30 reported cases, including one of their own. Twenty-four of the patients were infants from two days to two months of age; 6 were adults. According to these investigators the most significant etiologic factor is the lack of elastic tissue and relative preponderance of smooth muscle in the wall of the ductus predisposing to dilatation by the high pressure of the blood within the aorta. In 3 cases an infectious process was believed to be a contributory cause.

In the few instances where roentgenologic study was done during life, the aneurysm was seen as a rounded density in the left hilar region. Mackler and Graham stressed as a salient feature the location of the aneurysmal sac shadow in the superior mediastinum, in the

region of the pulmonary conus, posterior to the trachea. In the case reported in the present paper, in a premature infant, the aneurysm presented *anterior* to the trachea, possibly due to the origin of the ductus from the main pulmonary artery trunk rather than the left branch. Death resulted from cerebral infarction secondary to an embolus arising in the ductus aneurysm, lodging in the right internal carotid artery.

A chest film was not taken during life, but roentgenograms of the specimen of heart and great vessels after injection of thick barium paste portray the structure and anatomic features of the aneurysm in excellent fashion and are believed to be comparable to the contrast visualization which would be seen during life.

Four photographs; 5 specimen roentgenograms.

WILLIAM C. GALLO, M.D.
Indiana University

THE DIGESTIVE SYSTEM

Symposium—Diverticula of the Alimentary Tract. I. Diverticula of the Œsophagus. A. S. Johnstone. **II. Diverticula of the Œsophagus.** A. L. d'Abreu. **III. The Radiological Aspects of Diverticula of the Stomach and Small Bowel.** Richard Fawcitt. **IV. Diverticula of the Small Intestine.** Harold C. Edwards. **V. Diverticulosis and Diverticulitis of the Large Intestine (A Radiological Commentary).** J. L. A. Grout. **VI. Diverticula of the Colon.** Charles Wells. Brit. J. Radiol. **22:** 415–458, August 1949.

Johnstone points out that esophageal diverticula may be of three types etiologically—pulsion, traction, or a combination of these. They may again be classified as true, containing all the layers of the esophageal wall, and false, containing only a single layer. Most esophageal diverticula are acquired.

The posterior pharyngeal diverticulum of Zenker is typical of a pulsion diverticulum. In its earliest stages it is a small sac protruding through a weak spot in the wall just above the crico-pharyngeus muscle. It has no true muscle layer. Once the sac has formed, two forces tend to enlarge it, the pressure of swallowed food and the elevation of the pharynx during the act of swallowing.

Traction diverticula are more commonly found in the middle third of the esophagus, secondary to some inflammatory process such as tuberculous adenitis or mediastinitis. They are usually small and frequently multiple.

If a diverticulum retains barium for more than a few moments it is a potential source of danger.

Diverticula in the lower third of the esophagus may be the result of obstruction, inflammation, or ulceration. Many in this location produce no symptoms, though bleeding and ulceration are common. Hiatal hernia must be remembered in the differential diagnosis, and a rare anomaly, reduplication of the esophagus.

Complications are unusual, but include ulceration, perforation, abscess formation, bronchial fistula, mediastinitis and carcinoma.

Sixteen roentgenograms.

d'Abreu gives several case histories illustrating various types of diverticula. He believes that most diverticula are of pulsion type. Few produce sufficient symptoms to require surgery, but esophagoscopy should be done, as frequently a mild esophagitis may be found or a partial stricture, treatment of which will relieve symptoms.

Six roentgenograms; 1 photograph.

Discussing diverticula of the stomach and small bowel, *Fawcitt* states that a review of 16,000 barium studies shows that diverticulosis is commoner than is ordinarily supposed. Diverticula of the stomach and small intestine, like those of the esophagus, may be congenital or acquired, pulsion or traction, true or false.

The radiological features of gastric diverticula as set forth by various writers are: (1) a mobile sac, with broad or narrow neck, unattached to extra-gastric tissue; (2) a well defined smooth and regular shadow, noted from various angles; (3) generally no tenderness over the area of filling; (4) the presence of a niche-like opaque spot surrounded by a defect in the contrast shadow, resembling an ulceration without surrounding infiltration, best shown in a vertical position and during expiration; (5) demonstration of rugae in the mucosal lining of the neck; (6) location of the shadow most commonly at the cardia, on the lesser curvature toward the posterior wall; (7) retention of barium at the site of the shadow for six hours (not regarded as essential by the author); (8) well defined gastric rugae leading up to and into the diverticulum; (9) occasional ability to empty the sac by changing the patient's position. Gastroscopic examination is of great value in finally establishing the diagnosis. Nine illustrative cases are briefly presented.

Diverticula of the duodenum are commonest on the lesser curvature of the second portion, usually related to the blood vessels. Seven cases are briefly described.

Diverticula of the duodeno-jejunal junction are of special interest, as they may appear to be gastric. They can usually be located by rotating the patient in various positions. Five such cases are presented.

Diverticula of the jejunum are not common. They are usually found in the upper part of that section of the bowel and are often multiple.

In 3,000 barium meal examinations 5 gastric diverticula, 19 duodenal, 4 jejunal and ileal, and 2 Meckel's diverticula were found. Congenital diverticula may be seen at any age; the acquired type occurs in middle life or advanced years. The higher in the tract the more apt are the diverticula to give rise to chest pain or dyspepsia. Those lower are more apt to produce melena.

Twenty-one roentgenograms.

Edwards classifies diverticula of the small intestine as (A) congenital, including Meckel and non-Meckel diverticula, and (B) acquired, including the primary or hernial type, secondary diverticula due to disease of the bowel or of the traction type, and pseudo-diverticula.

Two types of non-Meckelian diverticula are found rarely, giant diverticula, which are probably reduplications of bowel, and diverticula associated with ectopic pancreatic tissue.

Meckel's diverticulum is the commonest type of congenital diverticulum, occuring in 1.5 to 2.0 per cent of otherwise normal individuals. It projects from the free border of the bowel and has a normal intestinal wall. It usually has a wide mouth, being cone shaped. Symptoms arise from either anatomical or physiological causes. The chief anatomical cause of trouble is the attachment of the diverticulum to the abdominal wall, either directly or as a result of unobliterated vitelline veins or irregularities in obliteration of the omphalomesenteric duct. Where such anatomical variation is present, the stage is set for intestinal obstruction. Physiological variations are usually due to the presence of aberrant gastric or pancreatic cells or both. These

are apt to produce a mass, and intussusception is likely to result. In the presence of gastric mucosa, ulceration and inflammation and even perforation may occur.

Acquired diverticula are usually of the hernia type and occur most commonly where the blood vessels enter the bowel or at the ampulla of Vater. They are more common in the duodenum and upper jejunum. They do not often produce symptoms, but when they do, these are usually the result of inflammation and a problem arises in treatment. It is not always possible to tell which diverticula are causing the trouble and resections of large portions of the bowel are necessary, as the diverticula are so frequently multiple.

Eleven illustrations, including 1 roentgenogram.

Grout, after a short history of diverticula and diverticulitis of the colon, cites the incidence of 8 per cent in 2,179 consecutive barium enema studies. The condition is slightly more common in males, and is more often seen after the age of 50, being quite rare in younger people.

There may be a demonstrable prediverticular stage, but its recognition with any accuracy is at best very difficult. Developed diverticula are readily recognized. They may be single or multiple. They usually have small narrow necks and may attain considerable size.

Diverticulitis is usually easily recognized, but is often difficult or impossible to differentiate from carcinoma. Both occur most commonly in the sigmoid. Diverticulitis is less apt to have definite borders. The narrowing of the bowel is likely to be spindle-shaped. While diverticulitis is not a precursor of carcinoma, the two may occur together.

Sixteen roentgenograms; 2 tables.

Wells, also discussing diverticula of the colon, points out that in the prediverticular stage there is a minute outpouching of mucosa at points of weakness in the bowel wall. These later blow up into the typical diverticula. Fecaliths are prone to form in the diverticula, though why they develop is not clearly known. Their development is probably not related to constipation. It is more likely the result of the aging process, or perhaps they are sequelae of localized inflammation.

Once diverticula appear in the colon, they never regress. Diverticulosis of the large bowel is synonymous with diverticulitis, as some degree of inflammation develops sooner or later. The end-results of the inflammation are resolution, fibrosis, suppuration, or gangrene. Amelioration of the inflammation may be obtained in the early stages by low-residue diet and lubrication. If this fails, surgery is indicated. Suppuration and gangrene lead to perforation, general peritonitis, and local abscess formation. Fibrosis may lead to obstruction. Fistulae may develop between the large and small bowel and into the bladder.

Twenty-two illustrations, including 13 roentgenograms.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Carcinoma of the Thoracic Esophagus. A Discussion of Early Diagnosis and Surgical Treatment. Lyman A. Brewer III and Frank S. Dolley. California Med. **71:** 97–102, August 1949.

Nearly all cases of carcinoma of the esophagus could and should be diagnosed promptly enough for successful surgical removal, since symptoms appear early and metastasis is relatively late. Actually the authors found only 30 per cent of the cases seen by them in 1946 and 1947 to be operable.

Dysphagia is the important symptom but it may not be relentlessly progressive—there may be periods of relief without therapy and belladonna may give relief in the early stages. Loss of weight may be rather great, due to slow starvation. Regurgitation of undigested food, substernal distress, and pain on swallowing may be present. Fever and deep boring interscapular pain usually mean mediastinal extension and inoperability.

Roentgen findings are extremely important in making the diagnosis and determining the extent of the lesion. An irregular filling defect extending longitudinally or circumferentially is pathognomonic. Benign lesions are smooth, and inflammatory lesions show a gradual tapering to the normal. Careful examination of the esophagus with thick and thin barium should be routine in every stomach examination, since symptoms may be referred to the stomach area. Early lesions can easily be overlooked if thin barium only is used in the upright position.

Esophagoscopy and biopsy confirm the diagnosis. The extent of the disease can often be predicted from the amount of fixation if there is no surrounding inflammation.

Transthoracic thoracolaparotomy is the procedure of choice with the stomach being brought up through the incised diaphragm for anastomosis to the proximal end of the esophagus. Mortality rates for the operation are being revised continually downward with better anesthetics, use of antibiotics, and increased familiarity with the technic.

Nine roentgenograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Diagnosis of Carcinoma of the Esophagus: The Method of Biopsy with the Retrograde Curette. Armistead B. Crump and George C. Hennig. Gastroenterology **13:** 153–159, August 1949.

Improved surgical technics of esophageal resection for carcinoma have increased the need for establishing an early diagnosis. Conventional esophagoscopic biopsies are usually effective. There are cases, however, in which such a biopsy is unobtainable or is reported as normal although the roentgen appearance suggests a malignant lesion.

These failures result from unsatisfactory visualization of the lesion or removal of normal tissue above the tumor. A retrograde bucket curette devised by the authors is recommended in such instances. This instrument is a hollow metal olive attached to the distal end of a flexible staff. The upper end of the olive contains four curetting edges. After being passed distal to the suspected esophageal area over a guide wire or swallowed thread, the olive is removed by a sharp jerking motion. This obtains tissue from almost the entire esophageal circumference at the lower aspect of the lesion, thus avoiding the redundant or edematous normal mucosa sometimes encountered at the upper aspect when an esophagoscope is used. Tissue samples may also be obtained from the extreme distal esophagus in this way, aiding in differentiation of invasive gastric carcinoma. No complications have been encountered in use of the instrument.

The authors evaluate diagnostic methods in 152 patients with proved squamous-cell carcinoma of the esophagus seen over an eighteen-year period at Presbyterian Hospital, New York City. Roentgen examination was performed in all but 6 cases, with a presumptive diagnosis of carcinoma in 92 per cent. In 7 cases a

normal esophagus was reported on the first examination. In this group 4 carcinomas were later discovered in the upper end of the esophagus, an area notably difficult of examination. An additional 5 patients were reported as having disease but a presumptive diagnosis of carcinoma was not made. Two were thought to have cardiospasm, one was thought to have an esophagitis, and "narrowing" was described in two cases.

Esophagoscopic biopsies performed in this series gave positive findings in 79 per cent of cases. Some cases required more than one biopsy to obtain a positive specimen. The retrograde curette, used in cases where esophagoscopic biopsy was negative, yielded positive findings in 18 of 20 cases.

One photograph; 9 drawings.

R. R. SURRATT, M.D.
Baton Rouge, La.

Giant Hypertrophic Gastritis. Clarence J. Berne and William R. Gibson. West. J. Surg. **57:** 388–391, August 1949.

The case reported here is considered an extreme example of a process producing giant gastric rugae. The treatment was total gastrectomy, and the authors claim that this is the third case of giant hypertrophic gastritis handled in this manner. A unique feature was the subsequent development of a morphologically similar process in the urinary bladder.

The patient was a Negress, aged 55, with a three-month history of anorexia, vomiting, and marked weight loss. The gastro-intestinal series revealed a narrow, stiff stomach with a palpable mass corresponding to a filling defect in the antral portion. All rugae were markedly altered. Peristalsis was absent, and the stomach did not empty well.

Total gastrectomy was done. The mucosal surface revealed a large number of giant rugae, found microscopically to be due to proliferation of the glandular structures. The pathological diagnosis was "chronic diffuse gastritis of undetermined etiology."

Three months after her discharge from the hospital, the patient was readmitted because of severe dysuria, frequency, and constant burning pain in the bladder region, of one week duration. Urinalysis revealed a few pus cells and numerous red cells per high-power field. Cystoscopy showed a small bladder capacity. The entire posterior wall of the bladder presented a diffuse irregular mass of proliferative epithelial tissue. Bladder drainage and finally bilateral cutaneous ureterostomy gave no relief, and the patient died.

At autopsy the esophagojejunostomy was in good condition. The urinary bladder was contracted and the wall thickened. On opening the bladder, there appeared many enlarged, villous, longitudinal folds, running from the posterior superior surface down to the ureteral orifice. Microscopic examination showed greatly thickened mucous membrane in all sections.

The development of a possibly similar process in the urinary bladder several months after gastrectomy raises the question of a carcinogen, virus, or unknown factor, which may have been responsible for both the gastric and bladder lesions. There was in the microscopic sections both from the stomach and the bladder sufficient squamous metaplasia of epithelial cells to suggest a possible neoplastic or pre-neoplastic process.

Seven illustrations, including 1 roentgenogram.

EDWARD E. LEVINE, M.D.
Dearborn, Mich.

Prolapse of the Gastric Mucosa into the Duodenal Bulb. Carlos Bonorino Udaondo, Victorino D'Alotto, and Esteban Cabanne. Prensa méd. argent. **36:** 1654–1659, Aug. 26, 1949. (In Spanish)

The authors' observations are based on 4 cases of prolapse of gastric mucosa into the duodenum. Aside from the report of these cases, which seem characteristic, the article contains a review of the literature, with especial reference to the work of Forssell, Golden, and Scott.

Thirteen roentgenograms. JAMES T. CASE, M.D.
Chicago, Ill.

Prolapsed Gastric Mucosa: A Possible Cause of "Gastric" Symptoms in Right Heart Failure. Myron Melamed and Abraham Melamed. Ann. Int. Med. **31:** 245–259, August 1949.

This report is concerned chiefly with 4 cases of right heart failure with gastro-intestinal symptoms, in all of which there was evidence of prolapse of gastric mucosa into the duodenum. Two cases were studied at autopsy, and in the others the diagnosis was based on clinical signs and symptoms.

Many theories have been advanced to explain the prolapse of gastric mucosa. One of the more logical explanations can be found during postmortem examinations of patients who have succumbed to congestive heart failure. In such states markedly redundant, edematous, and mobile gastric rugae and edema of the submucosa are present. It is suggested that such conditions provide an adequate basis for increased mobility of the gastric mucosa and subsequent prolapse into the duodenum, and that in many cases of congestive heart failure "gastric" symptoms are due to such an abnormality.

In the authors' first patient, the prolapse was evidently secondary to a congestive state of the stomach following myocardial infarction and cardiac decompensation. The major complaints of the 56-year-old patient were indigestion, epigastric pain, and vomiting. At autopsy the stomach wall was found to be thickened and the rugal folds were edematous and redundant. There were no erosions or ulcerations of the mucosa. The gallbladder was normal and no biliary calculi were present. The liver exhibited chronic passive congestion. The roentgen findings, consisting of a defect in the base of the duodenal bulb with rugal markings extending from the stomach into the duodenum, were indicative of a small prolapse of the mucosa.

The second patient, a 75-year-old white man with a long asthmatic history, was not examined roentgenographically. The postmortem findings, nevertheless, were so outstanding that one could not reasonably doubt that prolapse of the gastric mucosa had occurred during life. This patient had entered the hospital with signs and symptoms of progressive right and left heart failure. In the autopsy specimen the large gastric rugae could easily be swayed proximally or distally, in the latter case actually "flopping" across the pylorus. The folds were seen to extend beyond the pyloric ring into the duodenum. Microscopic sections revealed congestion and edema of the mucosa and submucosa, as well as the presence of eosinophils and plasma cells.

The other two patients presented clinical signs of right heart failure with cardiac enlargement. One case was an example of decompensated heart disease, with roentgen evidence of prolapse of the gastric lining; the other was another example of arteriosclerotic heart dis-

ease, decompensation, and prolapse of the gastric mucosa. This patient died soon after roentgen studies were made.

In all these cases, the "gastric" symptoms seem to be due, at least in part, to prolapse of the redundant folds.

The typical appearance of the prolapse in the duodenal bulb is that of a central "mushroom" or "cauliflower-like" negative shadow, or, an "atomic bomb" appearance in those cases in which a cuff-like prolapse occurs. One also observes a peculiar deformity of the distal stomach due to "tugging" by the slipping of movable gastric folds. If cases of prolapsed gastric mucosa are not to be overlooked, it is essential to perform serial studies as a part of all investigations of the upper gastro-intestinal tract. Sometimes only one or two of 8, 12, or 16 serial views will reveal a prolapse. The right lateral recumbent position offers optimum conditions for the study of the distal stomach and duodenal bulb and for the demonstration of prolapsed mucosa.

Ten illustrations, including 5 roentgenograms.

STEPHEN N. TAGER, M.D.
Urbana, Ill.

Chronic Intussusception. Henry A. Reisman and Arthur D. Wolk. Pediatrics **4:** 183–187, August 1949.

Two cases of chronic intussusception are presented. In neither was the clinical picture typical of intussusception, and in both the diagnosis was suggested by x-ray studies. In one, laparotomy revealed an invagination of the appendix on itself with attendant inflammatory changes in the terminal ileum and cecum; the other proved to be an ileocecal intussusception with an invaginated Meckel's diverticulum at its apex. Similar cases from the literature are cited and points made by various writers suggesting the diagnosis are mentioned.

Two roentgenograms.

HARRY J. PERLBERG, JR., M.D.
New York, N. Y.

An Unusual Experience with the Miller-Abbott Tube. R. M. Pool. Ann. Surg. **130:** 267–269, August 1949.

The author reports the case of a man of 63 who twenty years previously had had a posterior gastroenterostomy for multiple subacute perforating and bleeding duodenal ulcers. On the present occasion he was operated upon because of clinical and roentgen evidence of obstruction. Extensive adhesions and angulation of the first part of the jejunum were found and a gastrojejunal ulcer was present. The adhesions were freed and a bilateral vagal resection was done. Twelve days later, however, symptoms recurred. Insertion of a Levin tube and suction afforded temporary relief, but again evidence of obstruction developed. Preparatory to further operation, a Miller-Abbott tube was inserted. The following day fluoroscopy showed the tip of the tube in the small bowel. On the next day it was seen to have passed not only through the stomach and pylorus but through the duodenum and back through the gastro-enterostomy stoma, making almost three complete circles. An attempt at withdrawal was unsuccessful, and further roentgen study showed that the loops had been drawn tighter than on the previous observation; the tip lay in the region of the duodenal cap and the first part of a knot had been formed by two loops within the stomach. Operation was again done; the unhealed ulcer was excised, the obstruction was relieved, and the tube was divided into segments and removed.

While the author believes that use of the Miller-Abbott tube is definitely indicated in certain cases, he stresses the necessity of frequent fluoroscopic observation to determine its location, especially in patients who have undergone some type of intestinal anastomosis.

Two roentgenograms. E. S. KEREKES, M.D.
University of Arkansas

New Concepts of the Etiology, Diagnosis, and Treatment of Congenital Megacolon (Hirschsprung's Disease). Orvar Swenson, Edward B. D. Neuhauser, and Lawrence K. Pickett. Pediatrics **4:** 201–209, August 1949.

Twenty-six cases of Hirschsprung's disease were studied, of which 4 were in females. The onset of the disease was known to date from the first few weeks of life with a single exception, in which the first six-month history was not available. The entire clinical picture and course were consistent with partial obstruction of the large bowel. Large fecal impactions, usually in the left lower quadrant, were frequently outlined; however, rectal examination in these cases revealed an empty ampulla in all but two instances.

Since the clinical picture of megacolon can occasionally be produced by true organic obstruction, all these patients were subjected to a barium enema examination to rule out the presence of a congenital web or stenosis of the sigmoid or anus. The picture which each presented, that of a functional obstruction produced by a dyskinesia of the rectum or rectosigmoid, was detectable only on oblique films after a small quantity of barium had been allowed to run slowly into the rectum. Unless this technic is followed, the familiar picture of a colon dilated to the anus can be expected.

Up to 10 cm. of rectum or rectosigmoid was found to be constantly narrowed and frequently irregular in contour. Usually no peristaltic activity was exhibited by this segment, although occasionally a turbulent, purposeless peristalsis, sometimes reverse in type, was observed. After a small amount of barium had been allowed to enter the distended portion of colon, the area of dyskinesia was usually obscured.

A physiologic partial obstruction having been proved, a colostomy was performed on 3 patients. In each case, all symptoms resolved only to return on closure of the colostomy and to resolve again when it was reopened. Colostomies were then performed on 12 other patients with relief of symptoms and a marked decrease in the size of the colon. Thus, the dilatation of the proximal colon was considered the result of a long-standing partial obstruction due to a dysfunction of the distal narrowed bowel.

A special pull-through form of resection with preservation of the anal sphincter was devised, tested in the laboratory, and performed on 23 patients. In 15 cases a preliminary colostomy was performed because of the advanced state of the disease. There was no mortality in this series, and the children are now normal without the aid of any special regimen. Barium enema reexamination in 5 cases revealed a slight residual dilatation of the colon; emptying, however, was excellent.

Five roentgenograms; 1 photograph; 4 drawings.

HARRY J. PERLBERG, JR., M.D.
New York, N. Y.

Double Cancer of the Large Intestine. Three Cases. Abel N. Canónico. Prensa méd. argent. **36:** 1486–1496, Aug. 5, 1949. (In Spanish)

In two of the author's cases multiple tumors of the large bowel were discovered simultaneously, but in the third case the second tumor was found nearly two years after extirpation of the first lesion. This latter finding has been recorded at various times in the literature. Berson and Berger (Surg., Gynec. & Obst. **80:** 75, 1945) reported five cases of successive tumors of the large bowel with an interval of one, one and a half, seven and one half, ten, and eleven years, respectively. Miller (Ann. Surg. **80:** 456, 1924) reported two cases in which the second tumor occurred seven and eight years, respectively, after the first tumor. Cabot reported a case of cancer of the cecum followed ten years later by cancer of the splenic flexure. From the Mayo Clinic have come reports of multiple tumors, with various intervals.

The author considers it of importance that in none of his three patients were any polyps found in the vicinity of the tumor or even at a distance. Nevertheless, one cannot exclude the possibility that some double tumors in the intestine may have occurred on a basis of isolated polyps. The author discounts the possibility of metastasis as an explanation of the double tumor.

Fifteen illustrations, including 5 roentgenograms.

JAMES T. CASE, M.D.
Chicago, Ill.

Submucous Lipoma of the Colon. J. G. Stapleton. Canad. M. A. J. **61:** 159–162, August 1949.

Among the benign tumors of the colon, lipomas are second in frequency only to growths originating from the fibrous or muscular tissues of the intestinal wall. The author has assembled from the literature 130 cases with satisfactory clinical reports, to which he adds one more.

The usual locations in the colon, in order of frequency, are: cecum, ascending colon, sigmoid, transverse colon, rectum, and descending colon. Lipomas are definitely tumors of the "cancer age," the average age in 116 cases compiled by Pemberton and McCormack (Am. J. Surg. **37:** 205, 1937) being 47.5 years. Symptoms and signs are dependent on the size of the mass and the presence of complications such as torsion, hemorrhage, and intestinal obstruction, with or without intussusception. Intussusception occurred in 45 per cent of the surgical cases reviewed by Lazarus and Marks in 1945 (Am. J. Surg. **70:** 114, 1945). The preoperative diagnosis is usually carcinoma.

In the absence of obstruction the roentgen signs are those of a mass within the colon, arising from its wall. The tumor is seen as a filling defect, suggesting a polyp, and appears abnormally radiolucent for its size. When obstruction occurs—practically always the result of intussusception—the roentgen signs depend on the presence of a narrow central canal and a thin peripheral sheath separated by the intussuscepted mesentery and intestinal wall. The barium may suddenly stop or may enter the sheath, producing a "coiled spring" appearance. The colon proximal to the lesion is shortened and somewhat dilated.

Treatment is always surgical. If the possibility of malignancy cannot be fairly well excluded, radical resection of the affected portion of gut is indicated.

The author's patient was a 51-year-old female. Obvious symptoms were present for only three weeks, and are attributed to the occurrence of intussusception in the proximal tranverse colon. This was reduced at the time of the barium enema. A polypoid mass was demonstrated in the post-evacuation air-contrast film, in the proximal ascending colon. A one-stage resection of the right colon was done and a tumor was found attached to the base of the cecum. The pathological diagnosis was submucous lipoma.

Four roentgenograms; 1 photograph.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

A Case of "Porcelain" Gall Bladder, Renal Calculi, and Unusually Large Bladder Calculi. Victor Berman. South African M. J. **23:** 724, Aug. 27, 1949.

Brief notes on a case of calcified or "porcelain" gallbladder with right renal calculi and bladder calculi, demonstrated by roentgen rays and proved at autopsy.

Five roentgenograms.

Spontaneous Internal Biliary Fistula: A Review of the Literature and Report of Two Cases. Eugene A. Noskin, Alfred A. Strauss, and Siegfried F. Strauss. Ann. Surg. **130:** 270–276, August 1949.

Spontaneous internal biliary fistulas are said by the authors always to be secondary to disease within the biliary tree, although perforating peptic ulcers are mentioned as being responsible for 6 per cent of the cases. Gallstones are present in 90 per cent, and other etiologic factors, such as carcinoma of the gallbladder, abscess, etc., in the remaining 4 per cent. Fistula formation is for the most part dependent upon obstruction of the extrahepatic biliary duct system, with concomitant cholecystitis, pericholecystitis, and necrosis. In several large series of autopsied cases the incidence has been reported as from 4 per cent to 0.4 per cent. The present paper is concerned only with cholecystoduodenal fistulas.

Symptoms are not distinguishable from those caused by the underlying pathologic condition. Diagnosis is made by roentgen-ray or at operation. The demonstration of barium and gas in the biliary system following a barium meal, after failure to demonstrate the gallbladder by cholecystography, establishes the diagnosis.

Treatment may be conservative or surgical, the authors preferring the latter. Complications are: (1) cholangitis, (2) hepatitis, (3) intestinal obstruction, and (4) hemorrhage due to the erosion of a blood vessel.

The authors report 2 cases. In one the fistula was due to perforation by a calculus; in the other to a primary carcinoma of the liver.

Three roentgenograms; 1 table.

JOE B. SCRUGGS, JR., M.D.
University of Arkansas

Carcinoma of the Pancreas, a Clinical and Pathologic Study of Seventy-five Cases. Aaron Arkin and S. W. Weisberg. Gastroenterology **13:** 118–126, August 1949.

Early diagnosis of carcinoma of the pancreas is desirable if successful surgical resection is to be performed. Such a diagnosis is difficult largely because many of the tumors occur in the body or tail of the organ and in these cases jaundice is usually absent.

The series upon which the authors' observations are based consisted of 75 cases seen at autopsy. In 36 of these, the tumor arose in the body or tail of the pan-

creas, and in 2 in aberrant pancreatic tissue. Jaundice occurred in 6 of the cases with involvement of the body and tail; it was present in 31 of the 37 cases of carcinoma of the head. These observations, coupled with the fact that pain is of common occurrence, render untenable the old concept of painless jaundice as the characteristic picture. A patient complaining of abdominal pain not attributable to peptic ulcer, gallbladder disease, or renal colic, associated with weight loss, should be suspected of having a carcinoma of the pancreas.

Symptoms and clinical findings present in this series were: pain and weight loss (80 to 90 per cent); digestive disturbances, consisting of anorexia, nausea, vomiting, constipation and diarrhea; palpable liver (65 per cent); jaundice (45 per cent); palpable tumor (45 per cent); palpable gallbladder (33 per cent); ascites (25 per cent). Less frequently fever, leukocytosis, and edema of the lower extremities were present.

As a diagnostic aid roentgenographic study was of value in about one-half of the cases studied. Gastric and prepyloric defects, duodenal distortion or defect, displacement of the transverse colon and obstruction of the pyloric region or duodenum were reported. The possibility of misinterpretation of gastric or bowel invasion as primary bowel or gastric tumor, particularly if hemorrhage occurs, is pointed out.

Abnormal laboratory findings consisted in elevation of the icterus index, serum alkaline phosphatase, total serum cholesterol, blood amylase, and lipase. Urine urobilinogen was reduced or absent. Stools were acholic or clay-colored and contained blood if there was invasion of the bowel or stomach. Gastric analysis sometimes revealed anacidity. Hyperglycemia and even true diabetes developed from destruction of islet cells.

Necropsy findings revealed frequent metastasis in the liver (70 per cent), abdominal lymph nodes (56 per cent), lungs (20 per cent), peritoneum (20 per cent), adrenals (16 per cent), and other organs. Invasion by direct extension to adjacent organs and structures was common.

Eight tables.

R. R. SURRATT, M.D.
Baton Rouge, La.

Meconium Peritonitis. J. Richmond Low, George Cooper, Jr., and Lewis Cosby, Jr. Surgery **26:** 223–228, August 1949.

Meconium peritonitis is a sterile reaction in the peritoneum of the newborn infant resulting from the escape of intestinal content through a perforation of the intestinal tract. It can occur during intra-uterine life, at time of birth, or immediately after birth. A few more than 100 cases have been reported to date.

Approximately 50 per cent of the cases are associated with a demonstrable intestinal obstruction of one sort or another. For the remainder many causes have been listed, such as trauma, ulcers, etc. In some cases no satisfactory explanation could be found for the perforation.

The radiologic diagnosis is based on a picture of intestinal obstruction in a newborn child, with scattered calcifications in the peritoneal cavity. The calcification may occur as early as twenty-four hours after the onset of peritonitis.

The author reports a case in a four-day-old infant, with a preoperative roentgen diagnosis. At operation complete atresia of the terminal ileum was found. Though no definite perforation was identified, the bowel wall was extremely thin in one area. The child recovered following the surgical procedure and subsequent roentgenograms showed the calcium deposits to be disappearing.

Five illustrations, including 2 roentgenograms.

WILLIAM H. ROBINSON, M.D.
Cleveland Clinic Foundation

THE SPLEEN

Spontaneous Rupture of the Diseased Spleen. Edwin H. Ellison. Arch. Surg. **59:** 289–299, August 1949.

Spontaneous rupture of the diseased spleen (in the absence of adequate trauma) is a well-recognized occurrence, and is apparently increasing in frequency as a result of the many cases of relapsing vivax malaria in veterans. The outstanding clinical signs include intermittent pain in the left shoulder, especially during a malarial relapse, and rebound tenderness with pain referred to the left shoulder. General signs of intra-abdominal hemorrhage are present. Roentgenograms give critical aid in the diagnosis. The left leaf of the diaphragm is elevated, with increased left upper quadrant density, displacement of the stomach gas shadow to the right, and evidence of free fluid between the intestinal loops. The colon is displaced medially. There is obliteration of the splenic shadow, and the stomach is dilated, with serrations of the greater curvature.

An illustrative case in a 36-year-old man with malaria is reported, with onset during sleep. The characteristic roentgenographic signs are illustrated. Recovery followed splenectomy.

Nine illustrations, including 2 roentgenograms.

LEWIS G. JACOBS, M.D.
Oakland, Calif.

THE ADRENALS

Cushing's Syndrome Due to Tumor of Adrenal Cortex. Report of a Case of an Eleven Month Old Infant, with Apparent Operative Cure. Harold M. Goldstein. Am. J. Dis. Child. **78:** 260–278, August 1949.

This is a long, thorough, and interesting paper concerning an 11-month-old white child with clinical Cushing's syndrome. In this instance the manifestations were the result of a carcinoma of the adrenal cortex, and were fairly typical, particularly the findings of pronounced obesity, hirsutism, hypertension, and decreased dextrose tolerance.

Radiographic examination played an important role in the diagnosis, for whereas the flat abdominal film and intravenous urogram were negative, combined intravenous urography and laminagraphy demonstrated a tumor in the right suprarenal area, displacing the kidney caudad.

At operation a well encapsulated adrenal tumor was easily enucleated. The postoperative course was irregular and at times disconcerting, but the infant recovered, and eighteen months later appeared entirely normal.

The importance of special roentgenologic diagnostic methods and correct preoperative and postoperative management is emphasized.

Five illustrations, including 1 sectional roentgenogram.

EDWARD E. LEVINE, M.D.
Dearborn, Mich.

THE MUSCULOSKELETAL SYSTEM

Ewing's Tumor. Barton McSwain, Benjamin F. Byrd, Jr., and W. O. Inman, Jr. Surg. Gynec. & Obst. **89:** 209–221, August 1949.

Twenty Ewing's tumors, representing 10 per cent of 192 primary bone tumors, were found at the Vanderbilt University Hospital in the period from 1925 to the present. Three of the 20 patients (15 per cent) survived five years or more with no evidence of tumor remaining. In one patient, who survived fourteen years before dying of metastatic disease, disappearance of a metastatic area in the chest occurred without treatment to the area.

In a review of the literature, the authors found 565 cases of Ewing's tumor reported, with 51, or 9 per cent, five-year survivals. In no case was there recorded disappearance of metastases without treatment of them.

In the cases presented, pain and swelling were noted in practically all instances. The age incidence was between three and forty-three years, with 9 patients in the second decade. Most of the tumors occurred in males, and in the flat bones (14 cases). The roentgen findings were so varied that a positive diagnosis was made by the radiologist in only 5 of the cases found in the flat bones, and in none of those found in the long bones. The authors believe that the onion-peel formation, when present, is highly suggestive but not pathognomonic of Ewing's tumor.

Of 14 patients subjected to biopsy and irradiation only, 1 is still living. Two patients with excision of ribs, followed by irradiation, are both dead. Of 2 patients subjected to operation alone, 1 is still alive. One patient subjected to biopsy, irradiation, and amputation is still alive. So far as could be determined, in all the patients who died, death was due to the effects of the tumor.

Four case reports are presented.

Twenty-one roentgenograms: 5 photomicrographs; 7 tables.

ROY R. GREENING, M.D.
University of Pennsylvania

Osteoid Osteoma: Presentation of 22 Cases. Manuel de Azevedo Gomes. Gaz. méd. Portuguesa **2:** 511–529, 1949. (In Portuguese)

The 22 cases of osteoid osteoma reported here were treated in the Hospital for Special Surgery, New York. The case histories are given in some detail and the usual observations are recorded, with emphasis on the diagnostic importance of the radiologic examination. This is described as showing a nucleus of lesser density surrounded by a sclerotic zone.

Twenty-five roentgenograms; 17 photomicrographs; 1 table.

Coccidioidal Granuloma of Bone. David Miller and J. W. Birsner. Am. J. Roentgenol. **62:** 229–236, August 1949.

Seventeen cases of coccidioidal granuloma of bone from Kern General Hospital, California, are reviewed. Cases seen at this institution up to December 1941 were included in an earlier review by Benninghoven and Miller (Radiology **38:** 663, 1942). The colored race, Mexicans, and Filipinos seemed most susceptible to the disseminated lesions. The third and fourth decades are the most frequently involved age groups.

The roentgen findings were mainly osteolysis with occasionally some sclerosis. Some cases showed suggestive linear calcifications in soft tissues adjacent to bone. In no instance was there invasion of bony structures by extension from an overlying soft-tissue abscess, as reported by Benninghoven and Miller.

Serologic tests are helpful in diagnosis, but the skin test was of little or no value.

Eleven roentgenograms; 3 photographs; 3 tables.

RICHARD C. DATZMAN, M.D.
Indiana University

Atypical Multiple Myeloma. J. Jeanmart and G. Moriamé. J. belge de radiol. **32:** 30–37, 1949. (In French)

A 58-year-old male had suffered a violent trauma to the legs two months previously. There was no fracture, but since the accident he had undergone progressive asthenia, so that when the authors first saw him he was almost comatose, with severe anemia and icterus. The possibility of a neoplasm was suggested and rather exhaustive studies were conducted, which gave proof of a multiple myeloma. The findings included elevated blood globulin, increased blood nitrogen retention, and Bence-Jones proteinuria, with a conclusive sternal marrow study. Roentgenologically the only discoverable lesions in the entire skeleton were a small osteolytic lesion in the left scapula and one each in the left fifth and the right seventh ribs. Autopsy revealed a far advanced plasma-cell myeloma, with infiltration of the liver, kidneys, spleen, and numerous lymph nodes.

The various pathologic and hematologic classifications of the numerous types of myeloma are presented.

In the present case the atypical features were the lack of bone pain and the absence of spontaneous fractures despite a rather violent trauma suffered two months before death. Only the cachectic state of the patient led to investigations revealing the true nature of the disease.

Two roentgenograms.

E. M. SAVIGNAC, M.D.
Detroit, Mich.

Isolated Fracture of the Atlas: Report of Two Cases. David J. Graubard and Henry H. Ritter. Ann. Surg. **130:** 261–266, August 1949.

The authors report two cases of isolated fractures of the atlas. One patient was a 38-year-old man and one a boy of three and one-half years. In both instances the fracture was the result of an automobile accident. The anatomy of the atlas is reviewed and three methods for fracture are advanced. These are: (1) pressure of the dens against the anterior arch; (2) pressure between the skull and axis; (3) lever-like action on the posterior arch. Treatment is by hyperextension and immobilization.

Review of the literature reveals that the first reported case of isolated fracture of the atlas appeared in 1822. There has been a total of 56 cases reported (up to 1946), including those presented here.

One roentgenogram; 3 drawings.

JOE B. SCRUGGS, JR., M.D.
University of Arkansas

Solitary Plasmocytoma of the Spine. Ronald W. Raven and R. A. Willis. J. Bone & Joint Surg. **31-B:** 369–375, August 1949.

A case of solitary plasmocytoma (solitary myeloma) of the thoracic part of the spine, verified at autopsy, is

reported. Roentgenograms of a 56-year-old man showed partial destruction of the 6th and 7th dorsal vertebrae, suggesting metastatic carcinoma. Biopsy taken during laminectomy revealed typical compact masses of plasma cells. Roentgenograms of the other bones, and autopsy disclosed no other foci.

The radiographic appearances of solitary plasmocytoma are of two types: One type presents a cystic and trabeculated appearance; the trabeculae are thickened and irregular; the lesion is large, situated in the medulla of bone and often expanding the cortex. The second type is markedly osteolytic, resembling an osteolytic metastasis or an osteolytic osteogenic sarcoma.

Radiation therapy is effective since the tumors are very sensitive. Relief of pain is common, and regression, with recalcification of bone, is sometimes seen. While radiation is not curative, some tumors are held in check for years. In accessible sites, surgery may be combined with radiotherapy.

Except that the lesion is solitary, the pathology is the same as in multiple myeloma. Single tumors of short duration may be the forerunners of multiple myeloma. The Bence-Jones reaction is only rarely positive. Accurate diagnosis requires biopsy confirmation and exclusion of generalization by complete radiography of the skeleton. Eighteen acceptable cases of solitary plasmocytoma of bone have been recorded in addition to the present case. Three of these involved the spine.

Five illustrations, including 2 roentgenograms; 1 table.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Painful Shoulder. Significance of Radiographic Changes in the Upper End of the Humerus. Stewart H. Harrison. J. Bone & Joint Surg. **31-B:** 418–422, August 1949.

The author believes that degenerative processes involving the bone and soft tissues at the attachment of the musculo-tendinous cuff of the shoulder joint are frequent in the middle and later decades of life, and that such degenerative changes can often be shown radiologically before actual rupture of the cuff occurs. Occupational trauma is undoubtedly a causative factor. The roentgenographic appearance is in marked contrast to that of the normal shoulder. The roentgen findings indicative of a degenerative lesion are as follows: (1) irregularity of the cortical bone of the greater tuberosity; (2) loss of the normal outline of the anatomical neck; (3) erosion of bone of the articular surface of the head of the humerus; (4) cystic cavitation; (5) areas of sclerosis.

In a review of patients who had sustained shoulder injuries, it was found that those whose roentgenograms showed degenerative lesions had an average duration of hospital treatment of 49 days, compared to 18 days for those who showed no degenerative changes. Six to 12 months later all whose roentgenograms had shown degenerative changes still had residual disability. In contrast, those cases which had been diagnosed as "simple contusion" showed no serious residual complaints.

Injuries to the shoulder, however trivial, in patients over middle age, should be studied radiographically.

This article is one of an interesting symposium on shoulder pain. See also the following abstract.

Ten illustrations, including 6 roentgenograms; 2 tables.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Painful Shoulder. Calcification of the Supraspinatus Tendon. G. Blundell Jones. J. Bone & Joint Surg. **31-B:** 433–435, August 1949.

An uncommon type of painful shoulder, which has been recognized as a clinical entity, is described. The pain is of sudden onset and very severe. It is not usually precipitated by injury, often starting on simple movement of the arm or even on turning over in bed. All movement is limited by pain and muscle spasm, and the limb is held rigidly to the side; there is inability to rest or sleep. Roentgenograms taken shortly after the onset of symptoms show calcification in the area of the supraspinatus tendon.

Six cases are presented, in which treatment consisted of simple rest with heavy sedation to assure sleep, followed by active movements within the limits of pain as symptoms subsided. Spontaneous recovery with absorption of the calcified deposit took place in fourteen to twenty-eight days, and there had been no recurrence in a follow-up period of six months to five years. The author believes that the occurrence of spontaneous recovery in this condition has not been sufficiently emphasized.

Ten roentgenograms.

Tomographic Study of the Adult Sternum and Sternoclavicular Articulations (Three Cases of Osteo-articular Tuberculosis of the Sternum). R. Herdner. J. de radiol. et d'électrol. **30:** 508–513, 1949. (In French)

The difficulty of radiographic demonstration of the sternum and sternoclavicular junction is discussed. Various methods of tomography have been tried. A tube carriage moving parallel to the table is used. Roentgenograms are shown to demonstrate the normal sternoclavicular junction, a neoplasm of the clavicle next to the junction, and three cases of tuberculosis of the chondrosternal junction. Tomography with the patient in the lateral position demonstrates changes on the anterior margin of the sternum.

Six roentgenograms.

CHAS. NICE, M.D.
University of Minnesota

GYNECOLOGY AND OBSTETRICS

Extragenital Pelvic Tumors in Women. Sim B. Lovelady and Malcolm B. Dockerty. Am. J. Obst. & Gynec. **58:** 215–234, August 1949.

This review, from the Mayo Clinic, covers a period of thirty-eight years, from 1910 through 1947; 127 extragenital pelvic tumors in women were studied. While all ages were included, particular interest centered on those cases complicating pregnancy. Ten of the tumors were in this group.

The lesions were classified into four groups, according to their pathologic characteristics: congenital, neurogenic, osseous, and miscellaneous. The congenital group embraced 72 cases, or 57 per cent of the total, with a high incidence of ectopic pelvic kidneys (56 cases). Fourteen teratomas, of which all were benign but one, and 2 cases of the rare anterior sacral meningocele made up the rest of this group.

The neurogenic group consisted of 12 cases: ganglioneuromas, neurofibromas, and ependymomas. The osseous group—18 cases—included both benign and malignant lesions. Purely cartilaginous tumors were generally of a low grade of malignancy and most difficult to cure. Two cases of osteogenic sarcoma and 1 of Ewing's tumor proved fatal. The cases comprising

the miscellaneous group included myogenic tumors, inflammatory masses, fibromas, and metastatic carcinomas.

Symptoms are of little value in the diagnosis of these extragenital tumors. The most accurate method is an adequate pelvic and rectal examination. An excretory urogram is almost mandatory in ruling out the presence of an ectopic pelvic kidney. Roentgen examination of the pelvic bones, and particularly of the anterior sacral wall, is of value in those cases with evidence of bone destruction and may be of help in diagnosing an anterior meningocele in cases in which spina bifida occulta of the sacral vertebrae is present. In the series reported here, the roentgenologist reported the presence of a soft-tissue tumor in 6 instances, evidence of bone changes in 22, and both bone changes and a soft-tissue tumor in 6. In 23 cases the results of roentgen examination of the pelvis or sacrum were negative. Only by exploration can the exact nature of the tumors be determined, and the final diagnosis rests with the pathologist.

Treatment is surgical removal, with roentgen and radium therapy where possible as therapeutic aids. Where indicated, the orthopedist and neurosurgeon should be consulted. Therapeutic abortion is not indicated in cases where the tumor complicates pregnancy because most of these lesions are benign and those that are malignant recur slowly.

Five roentgenograms; 16 photomicrographs; 4 drawings; 1 photograph.

HARVEY J. THOMPSON, JR., M.D.
Jefferson Medical College

Hysterography (A Diagnostic Method in Cervical Cancer). Simone Laborde and Jean Montagnon. J. de radiol. et d'électrol. **30:** 505–507, 1949. (In French)

Injection of contrast medium has been used as a means of studying the uterine tubes. The authors point out that hysterography with lipiodol will also demonstrate filling defects due to tumors of the endometrium and endocervix. Its chief value is in determining the extent of tumor growth.

Five roentgenograms.

CHAS. NICE, M.D.
University of Minnesota

Further Radiological Studies in the Investigation of Obstetric Disproportion with Especial Reference to the Contracted Pelvic Outlet. E. Rohan Williams and Humphrey G. E. Arthure. J. Obst. & Gynaec. Brit. Emp. **56:** 553–575, August 1949.

In Part I of this paper, *The Value of Radiological Examination in Suspected Disproportion*, the authors report a survey of 300 cases in which pelvimetry was done at Queen Charlotte's Maternity Hospital, London, between January 1941 and July 1947. The results are compared with an earlier series of 300 cases from the same institution (J. Obst. & Gynaec. Brit. Emp. **53:** 125, 1946. Abst. in Radiology **48:** 312, 1947), and the two series are considered together in order to ascertain the reliability of the prediction of the course of labor, in terms of cephalopelvic disproportion, from the antenatal radiologic study alone.

The prediction groups were: (*a*) no disproportion; (*b*) no disproportion, with minor reservations; (*c*) minor disproportion, with normal delivery feasible; (*d*) moderate disproportion, with normal delivery improbable; (*e*) severe disproportion, with normal delivery impossible.

The evaluation of the predictions was as follows:

	First Survey, %	Second Survey, %	Combined Surveys, %
Correct	83	80	81.43
Cases in which forceps were used for other reasons than disproportion	7.11	12.05	9.67
Substantially correct	90.11	92.05	91.10
Incorrect	9.88	7.95	8.90

In the earlier survey the errors were chiefly in predictions of minor and moderate disproportion. These predictions still showed the highest percentage of errors in the second survey, but there was an increased number of errors in predictions of "no disproportion," due presumably to an attempt to eliminate the unduly pessimistic attitude evidenced in the first survey.

Brief histories of 9 cases in which incorrect predictions of no disproportion were made are included.

Part II of the paper is headed: *The Radiological Study of the Contracted Pelvic Outlet.* It is obvious from the number of pelvimetries which were done on normal pelves that the authors offer confirming radiological evidence in cases in which the obstetrician is uncertain of the normal more often than they aid in the diagnosis of contracted pelves. They believe, however, that careful radiological examination in such cases can provide most valuable information concerning the dimensions and capacity of the lower pelvic strait and the architectural character of the pelvis.

Prognostic data concerning the bony pelvic outlet as set forth by various authorities are considered and a series of 45 cases with outlet contraction studied from this point of view is recorded. The technic employed calls for roentgenograms as follows: anteroposterior, with the patient supine; supero-inferior, designed to show the size and shape of the inlet; lateral, with the patient erect; and a subpubic arch projection. When a "borderline" or obviously contracted pelvis is shown to be present, reconstruction charts are made of the pelvic inlet from the supero-inferior projection and of the median plane of the pelvis from the lateral projection on which the inclination of the descending rami is marked. With the use of the subpubic arch projection and a circular disk, 9.5 cm. in diameter, representing the average full-term fetal head, an estimate is made of the depth from the lower symphysial margin to which the head will have to descend before it can use the subpubic arch in the later stages of delivery. This distance is marked off on the descending rami on the median plane reconstruction chart, and from this, the available anteroposterior diameter of the lower strait is obtained. The ischial bispinous diameter is measured from the supero-inferior roentgenogram and subsequently corrected. Moir's outlet charts (Edinburgh M. J. **48:** 361, 1941) were found useful in assessing the capacity of the lower pelvic straits. Reference is made, also, to Moir's later studies on the "Graph Method" (See Absts. in Radiology **49:** 650, 1947; **54:** 468, 1950).

On the basis of the cases studied, it is suggested that the strictly borderline pelvic outlet for an average full-term head may be regarded as one in which the sum of the available anteroposterior and ischial bispinous

diameters slightly exceeds 21 cm. This corresponds to an area of 86 sq. cm.

While it is fully appreciated that these two diameters are not in the same plane, jointly they are believed to provide a better combination whereby the lower strait capacity can be assessed, than any other combination of diameters previously used. By the use of this combination, allowance is made for the influence of the narrow arch. Whether the ischial spines will directly cause an arrest can best be judged by a reconstruction of the outlet.

Six illustrations; 5 tables. S. F. THOMAS, M.D.
Palo Alto, Calif.

The Urinary Bladder During Labor. Herman I. Kantor, Jarrell E. Miller, and John C. Dunlap. Am. J. Obst. & Gynec. **58:** 354–364, August 1949.

By cystographic and cystometric procedures the authors studied the effect of labor on the urinary bladder of patients selected at random at Parkland Hospital (Dallas, Texas). The following phases of labor were studied: (1) early in labor, prior to engagement; (2) at the time of engagement; (3) during labor, with the presenting part well past the inlet, with both cephalic and breech presentation; (4) late in labor, with the presenting part near or on the pelvic floor; (5) immediately following delivery of the head; (6) immediately following delivery of the fetus. An orienting film, a film with the bladder distended by 150–300 c.c. of 25 per cent aqueous sodium iodide, and a film obtained with minimal quantities of the contrast medium were obtained for each patient, using lateral views only.

In order to obtain cystometric readings with the bladder empty, a Foley catheter was introduced into the bladder and 12 c.c. of water were injected into the bag. The bag outlet was connected with a water manometer, and equilibrium was established at about 50 cm. The patients were given low spinal anesthesia or demerol to control spontaneous expulsive efforts, and readings were taken during uterine contractions both with the bladder empty and distended with 50 to 400 c.c. of water. Then the effects of respiration and of voluntary straining were observed.

The following conclusions were established from these studies:

1. The location of the bladder depends upon the degree to which the fetal parts fill the pelvis.
2. A distended bladder can obstruct descent of the presenting part early in labor, hence evacuation is essential.
3. Routine catheterization is unnecessary prior to spontaneous delivery or to the application of low or outlet forceps.
4. Abdominal palpation of the bladder just prior to delivery may be physiologic.
5. Extravesical pressure due to uterine contraction and fetal descent averages 5 cm. of water. Straining pressures above 50 cm. of water were noted with the bladder empty or distended.
6. Pressure on the bladder can often be demonstrated even with the presenting part on the pelvic floor. Catheterization does not relieve this pressure, since it does not change the location of the pelvic portion of the bladder.

Seventeen roentgenograms; 1 drawing; 1 chart.
HARVEY J. THOMPSON, JR., M.D.
Jefferson Medical College

THE GENITO-URINARY SYSTEM

Observations on the Technique and Interpretation of Intravenous Urograms. Truchot. J. belge de radiol. **32:** 1–9, 1949. (In French)

This article deals essentially with the functional study of the urinary tract by intravenous urography. The author passes rapidly over the morphologic information which the method affords and insists that the entire procedure should be considered primarily as a physiologic test without the interference of catheterizations and instrumentation, which lead to functional disturbances. Excretion of the contrast medium is an expression of tubular function, while laboratory tests depending on the secretion of urea reveal glomerular function. Certain apparent discrepancies in laboratory and radiologic methods can thus be explained.

For the study of excretion, the author, one of the originators of fluoroscopic pyeloscopy, considers intravenous urography the best method. He states that normally the urine is carried by the pyelo-ureteral muscle in a continuous peristaltic motion from the calices to the urinary bladder. Whenever any pathologic factor intervenes, certain nodal areas of spasm appear at various regularly recurring points along the muscle to produce typical images. These areas of spasm may occur at the following sites: (1) the minor calices, producing a non-functioning kidney or a nephrogram; (2) the junction of the major and minor calices, producing rounded coin-like images of the distended minor calices; (3) the ureteropelvic junction, with an image of a distended renal pelvis with small calices and a small ureter; (4) two or three lumbar ureteral segments; (5) practically always an area in the terminal portion of the ureter. The most frequent pathologic stimulus responsible for these areas of spasm is a calculus.

The author considers the muscle tone of the pyeloureteral apparatus of primary importance. The tone of this hollow smooth-muscle tube determines its size and volume and is studied as follows: The first film following the intravenous injection is obtained without abdominal compression, the second after several minutes of compression, and the third immediately upon release of compression. Normally the pelvis and calices distend in all their diameters during compression, and return to a normal size on release of compression. In hypertonic states, compression produces pain and very little distention of the lumina; the response to decompression is immediate and violent, producing only thin streaks of a pyelographic image. In hypotonic states, distention is exaggerated during compression and the return to the resting phase after decompression is slow and sluggish. These findings occur only if there is muscle tissue remaining in the renal pelvis; if the muscle has been destroyed by suppuration or neoplasm, there is no response to the compression-decompression study.

The author cautions against the use of the term nonfunctioning or "dead" kidney following routine urography. All we are entitled to state is that no opaque urine appeared during the study. Extended and repeated observations are necessary before diagnosing a "dead" kidney. Similarly the use of the term hydronephrosis, as meaning a permanent and irreversible lesion, is not justifiable on the basis of a single urogram or of a retrograde pyelogram showing mechanical overdistention of the renal lumina. Repeated studies of the

muscle tone of the pelvis and calices show that alterations are frequently sequelae of a low-grade pyelonephritis, which can and does improve as judged by follow-up studies. E. M. SAVIGNAC, M.D.
Detroit, Mich.

Value of Upright Films in Intravenous Urography. E. M. Van Ussel. J. belge de radiol. **32:** 10–13, 1949. (In French)

The upright film is invaluable for detection of the presence of the abnormally movable or ptosed kidney with or without kinking of the ureter. Such kidneys are usually in a normal position when the patient is recumbent and their presence cannot be discovered unless a film in the upright or semi-upright position is obtained.

Recumbent films are taken without abdominal compression and then with compression. Without release of the compression, the table is then tilted to a semi-upright position and the tube is shifted so that the principal ray is perpendicular to the abdomen. It is highly important to maintain the same target-film distance as in the recumbent study, since otherwise comparable views of kidney position are not obtained. The compression is removed just before the exposure is made and before the renal pelvis has had a chance to empty itself.

The author claims that the semi-upright position eliminates the exaggerated lumbar lordosis which prevails when the patient stands erect.

Six roentgenograms; 1 drawing.
E. M. SAVIGNAC, M.D.
Detroit, Mich.

Pancreatic Cysts Simulating Renal Disease. Eric P. Stone. J. Urol. **62:** 104–117, August 1949.

Occasionally pancreatic cysts, when encountered in the field of urology, present unusual diagnostic and surgical difficulties. There are a number of laboratory tests, *i.e.* serum amylase determinations and stool examinations, which are helpful when pancreatic disease is suspected, but on the whole roentgen examination of the upper gastro-intestinal tract is the most specific aid. Widening of the duodenal loop is noted in cysts of the pancreatic head; cysts in the body are prone to cause a pressure defect of the lesser curvature, while those of the tail produce a smooth, rounded indentation of the greater curvature at or just above the mid portion of the stomach. Lateral roentgenograms of the barium-filled stomach are especially helpful. As the size of the cyst increases, the x-ray findings become more apparent. Splenic enlargement, echinococcus cysts, and retroperitoneal tumors can usually be excluded by clinical means.

The case history of a 31-year-old man in whom a pancreatic cyst was mistaken for a tumor springing from the upper pole of the left kidney is presented in detail. In explanation of the development of the pancreatic cyst in this patient it is proposed that the dorsal bud of the pancreas became adherent to the mesonephron of the left kidney and that, as the position of the two changed during their development, pancreatic tissue was drawn away from the main body and two bits developed into heterotopic organs within the left renal fossa. Pancreatic cysts have been known to follow abdominal injuries.

Operative treatment of 80 cases of pancreatic cysts is reviewed and the results are tabulated. Drainage and/or marsupialization of the cyst appears to be the preferred surgical treatment. A second table summarizes the cases of pancreatic cysts affecting the genito-urinary tract reported in the literature.

Seven illustrations, including 3 roentgenograms; 2 tables. ALTON S. HANSEN, M.D.
Peoria, Ill.

Retrocaval Ureter: Report of a Case with Successful Plastic Repair. Thomas P. Shearer. J. Urol. **62:** 152–157, August 1949.

A case of retrocaval ureter in a woman of twenty-four years is reported. The diagnosis was made by retrograde pyelography and plastic repair was successfully effected. This is said to be the thirty-eighth case of the anomaly to be reported and the seventh with successful repair.

The diagnosis of retrocaval ureter is a roentgenologic problem. Roentgenograms in the reported cases show a similar deformity in all. The middle third of the ureter is displaced medially, while the upper third appears to curve sharply laterally, joining a second curve which goes cephalad, ending in a marked hydronephrosis. It is suggested that this peculiar "S"-shaped deformity, found in the upper third of the right ureter, accompanied by a displacement of the middle third to the midline, may be pathognomonic of postcaval ureter.

Six illustrations, including 5 roentgenograms.
ALTON S. HANSEN, M.D.
Peoria, Ill.

Twenty-four Years of Radiologic Diagnosis of Bilharziasis in Egypt. P. C. Smyrniotis. J. de radiol. et d'électrol. **30:** 514–517, 1949. (In French)

Bilharziasis in Egypt is due exclusively to *Schistosoma hematobium* and *Schistosoma mansoni*. It is estimated that 10,000,000 of the 16,000,000 inhabitants of the country are infected. Roentgenograms demonstrating the condition have been published from time to time since Lotsy's first demonstration of the disease in the urinary tract of a patient from Cairo in 1913. The present writer's studies date back to 1926. Air cystography was originally used but has been supplanted by the hydrocystogram.

The author calls attention to the fact that, while we usually think of bilharziasis as a disease of the bladder and adjacent tissues, infestation of the lungs and other viscera (pancreas, stomach, appendix, mesentery, lymph nodes, and central nervous system) is not uncommon; bilharziasis of the liver is of frequent occurrence, and bilharziasis is the principal cause of splenomegaly in Egypt. Involvement of the skin, nose, and eyes is also seen.

Four hydrocystograms. CHAS. NICE, M.D.
University of Minnesota

Cyst of the Seminal Vesicle. B. Lyman Stewart and Gordon A. Nicoll. J. Urol. **62:** 189–195, August 1949.

A case is reported of a cyst of the seminal vesicle. Only 8 earlier cases were found in the literature. These cysts all contained a bloody fluid attributed to stretching of the cyst wall producing bleeding. They are believed to be the result of an obstructive process in the ejaculatory duct. In the case reported, vesiculography revealed a round, sharply demarcated mass. At operation this was found to be incorporated between the two

seminal vesicles, involving primarily the left vesicle. It is believed that in most cases a diagnosis could probably be made by vesiculography. Resection of the cyst and involved vesicle is considered the treatment of choice when symptoms are present.

One roentgenogram; 2 photomicrographs; 1 table giving details of reported cases.

THE SPINAL CORD

Multiple Primary Tumors of the Spinal Cord. Report of Case. Hendrik J. Svien, John D. Camp, and Alfred W. Adson. S. Clin. North America **29:** 1223–1231, August 1949.

The authors report a case in which three primary neoplasms of the spinal cord were removed successfully. The patient was a white woman, 29 years of age when first seen, in March 1935, complaining of difficulty in walking for three years. A fusiform mass 5 by 10 cm. was present in the right superior carotid triangle. Neurologic signs and symptoms pointed to a tumor in the spinal cord at the level of the fourth and fifth thoracic vertebrae. On April 5, 1935, a laminectomy revealed a mass under the dura 2 cm. in length and 2.5 cm. in diameter, which proved on microscopic examination to be an *intradural, extramedullary meningioma.* Eight days later the neck tumor was removed and proved to be a neurofibroma. For the next twelve years the patient remained well. In 1948 she was again seen, with neurologic signs and symptoms which indicated the presence of at least two lesions of the central nervous system: (1) a tumor of the left cerebellopontine angle and (2) a lesion of the spinal cord in the cervical region. Myelography revealed the presence of a complete subarachnoid block at the level of the fourth thoracic vertebra and partial block at the level of the interspace between the first and second lumbar vertebrae. In October 1948, two laminectomies were done at twelve-day intervals with removal of an *intradural, extramedullary neurofibroma,* from the anterior root of the fifth cervical nerve on the left and a *neurofibroma* from the posterior root of the fourth lumbar nerve on the right. Symptoms disappeared in a period of two and a half months.

Dr. Camp, in the discussion of this case, stated that in his first study of multiple tumors of the spinal cord (Am. J. Roentgenol. **36:** 775, 1936. Abst. in Radiology **29:** 758, 1937) 4 per cent of tumors that were localized by myelography were diagnosed as multiple by the radiologist and in all cases the diagnosis was confirmed at surgery. He offered the following classification of multiple cord tumors for roentgenologic consideration:

I. Multiple tumors arising from the same nerve
   A. Neurofibromas
   B. Neurofibromatosis
II. Multiple discrete unrelated tumors.
III. Protruded disk and tumor.
IV. Multiple protruded disks.

Two roentgenograms; 2 photomicrographs; 2 photographs.

HARRY HAUSER, M.D.
Cleveland City Hospital

Calcification in Intraspinal Meningiomas. Gordon J. Culver, Joseph P. Concannon, and E. C. Koenig. Am. J. Roentgenol. **62:** 237–246, August 1949.

The significance of irregular calcification within the vertebral canal is emphasized by this report of 5 meningiomas (out of a series of 15) containing sufficient calcium to show roentgenographically. No calcium was demonstrable within any other type of intraspinal tumor. Calcified protruded intervertebral disks offer no serious diagnostic problem even when they occasionally appear in the thoracic area, since the associated roentgenographic signs are entirely different and myelography usually shows an extradural defect without any significant degree of block.

Meningiomatous calcification arises in areas with abundant psammoma bodies. It frequently gives rise to a homogeneous increase in the density of the tumor, which may be best seen on the lateral spinal view as an ovoid area of increased density. If the psammoma bodies fuse to form calcium spicules, or actual osteoblastic activity takes place to produce bone, a sharp, discrete, irregular mass of calcification is seen on anteroposterior and lateral films. At other times, only flaky calcific densities betray the type and location of the tumor. It is pointed out that some meningiomas do not contain sufficient calcium to be visible, regardless of roentgenographic quality, while in some the fine calcification may be missed because of superimposed rib shadows. Tomography is suggested as a means of avoiding this latter error in suspected cases of cord tumor. The authors present brief reports of their 5 cases and add 1 case of intraspinal calcification in the dorsal area in a herniated intervertebral disk.

Ten roentgenograms; 4 photomicrographs; 3 tables.

J. A. CAMPBELL, M.D.
Indiana University

THE BLOOD VESSELS

Abdominal Aortography (Technic, Incidents and Accidents, Indications, Results). J. Ducuing, H. Pons, and A. Enjalbert. J. de radiol. et d'électrol. **30:** 497–504, 1949. (In French)

The technic, incidents and accidents, indications, and results of abdominal aortography are discussed. The team consists of radiologist, anesthetist and surgeon. The patient is given an enema the evening before the examination, and pre-anesthetic medication, morphine and atropine, is administered intravenously one hour before the procedure. Coramine or adrenalin should be readily available. A needle 12 cm. long, with a bore of 1.2 mm., is used. With the apparatus of Dos Santos, the contrast material can be injected under a constant pressure of 1.5 to 2.0 kg., at a rate of 3 c.c. per second or more. Usually the medium used is sodium iodide, 100 per cent chemically pure; more than 10 to 12 gr. of the product is never used.

The injection is made at the level of the twelfth thoracic vertebra to study the entire vascular tree of the abdominal aorta, and at the level of the second or third lumbar vertebra to study the pelvic circulation. The area of L-1 and 2 is avoided in order to prevent direct injection into the renal artery. After 10 to 12 c.c. of the contrast substance has been introduced, the film is exposed and 20 c.c. of 1 per cent novocaine is injected to prevent vasospasm.

Indications for abdominal aortography include:

1. Aortic lesions: aneurysm, arteritis, occlusions.
2. Study of the vascular tree of the liver, spleen, and especially the kidney. Demonstrable renal findings include, renal anomalies (unilateral kidney, horseshoe kidney, etc.), anomalies of vascular pedicle, and aberrant vessels associated with hydronephrosis.
3. Study of the circulatory pattern of abdominal

and pelvic tumors, analogous to study of cerebral tumors by angiography.

4. A rare indication is study of the vascularity of the corpora cavernosa, which is diminished in impotence.

Ten roentgenograms show normal and pathological findings; 5 drawings illustrate the technic.

CHAS. NICE, M.D.
University of Minnesota

Intermittent Claudication: A Clinical Study. A. M. Boyd, A. Hall Ratcliffe, R. P. Jepson, and G. W. H. James. J. Bone & Joint Surg. **31-B:** 325–355, August 1949.

The immediate cause of intermittent claudication is diminution of the arterial supply to the muscles concerned. Cases of deficient circulation in the lower limbs are classified under 3 main headings: (1) primary thrombosis of the popliteal artery; (2) juvenile obliterative arteritis (Buerger's disease); (3) senile obliterative arteritis, including (*a*) diffuse obliterative arteritis, (*b*) secondary popliteal thrombosis, and (*c*) secondary femoral thrombosis. The authors' observations are based on a series of 472 cases.

In primary thrombosis of the popliteal artery, the earliest arteriograms show a localized narrowing and irregularity of the arterial lumen in the middle of the popliteal fossa. One end of the thrombosed segment is often found at the level of the knee joint, suggesting that the causative process begins at this level. The extent of the occluded segment varies. It may extend from the level of the knee joint to the adductor opening; from the level of the knee joint to the termination of the artery; or throughout the whole length of the artery from the adductor opening to the bifurcation.

In juvenile obliterative arteritis (Buerger's disease), the obliterative process begins in the small arteries of the feet. Gradually it ascends the limb until the popliteal or even the femoral vessels are occluded. The disease is always bilateral. Arteriography in early cases shows narrowing and finally obliteration of the small arteries of the feet. The proximal spread of the disease is demonstrated in the same manner. Collateral vessels show a corkscrew appearance which is associated characteristically with rapid hypertrophy and dilatation, a feature less marked in distal obliterative arteritis of arteriosclerotic origin.

Senile obliterative arteritis accounts for most cases of intermittent claudication. In *diffuse obliterative arteritis,* arteriography commonly shows narrowing and irregularity of the main vessels, with a beaded appearance of the larger ones. The smaller branches are abundant, with a well developed collateral pattern. Calcification is often present. In a smaller group of cases the changes in the large vessels are less marked and there is a paucity of muscle branches, which appear to end abruptly, with an absence of collateral anastomosis.

Secondary popliteal thrombosis is a common complication in patients with diffuse arterial disease. The arteriographic picture resembles that of primary popliteal thrombosis. The onset of thrombosis may be due to injury or to lowering of the blood pressure, with diminution of the blood flow because of confinement to bed.

In secondary femoral thrombosis, arteriograms show occlusion of the superficial femoral artery from the adductor opening to the point where the profunda femoris leaves the main trunk. Thrombosis has been shown to begin in the region of the adductor opening, proximal extension being limited by the brisk flow of blood through the profunda femoris. There may be gross deformity of the femoral vessel at the level of the adductor opening, where the artery may be tethered to the margin of the tendinous opening.

Nearly all patients under the age of thirty-five who complained of intermittent claudication in the calf muscles were found to have thrombosis of the popliteal artery. Juvenile obliterative arteritis seldom begins after that age. The process originates in the small arteries of the feet, and intermittent claudication starts at the small muscles of the soles. Senile obliterative arteritis accounts for practically all cases of organic obliterative arterial change after the age of forty. It is the most frequent cause of occlusive arterial disease between the ages of thirty and forty.

This article is an excellent review of all of the clinical aspects of intermittent claudication. The 14 arteriographic reproductions are excellent. Unfortunately the technic of arteriography is not included.

Seven tables; 8 drawings.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

TECHNIC

Rotatory Kymography from Multiple Centers. Two Years' Experience. Mario Lenzi. Radiología (Buenos Aires) **10:** 83–108, September–December 1947. (In Spanish)

The Argentine *Radiología* appears to be about two years behind in appearance, the September–December 1947 number having been received only recently.

This discussion of "rotatory kymography from multiple centers" largely duplicates that appearing in Acta radiol. **31:** 358, 1949. Abst. in Radiology **54:** 791, 1950.

JAMES T. CASE, M.D.
Chicago, Ill.

Technical Principles of Regmography. Ayres de Sousa. Gaz. méd. Portuguesa **2:** 543–552, 1949. (In Portuguese)

The author describes a procedure involving the rapid rotation of a film before a window in a lead screen, whereby a set of images may be obtained corresponding to "the semicycles of the current that supplies the x-ray tube." With this technic, which is called regmography, as many as 100 images per second can be obtained. It is believed that the method will find special application in experimental studies on relatively small laboratory animals, as the rabbit.

Fourteen illustrations.

New Apparatus for Preparation of Radiographic Stereoscopic Pairs of Small Format and Explanation of a Procedure for Obtaining the Radiographs, Posterior View, without Change of Position. Godenne. J. belge de radiol. **32:** 98–110, 1949. (In French)

For stereoscopy the author uses either small films or sections of larger films and a small hand stereoscope. Three views are taken; one normal view and a stereoscopic pair which gives a posterior view. This latter is obtained by moving the tube in the direction opposite the eye used in viewing each film, *i.e.*, the tube is moved to the right to expose the film viewed by the left eye, and

vice versa. Many thousands of patients have been examined in this manner in the past seven years. The procedure is especially useful in studying details of the wrist, elbow, pelvis, and skull, and in precise localization of small foreign bodies.

Twenty-six illustrations including 14 roentgenograms.

CHAS. NICE, M.D.
University of Minnesota

X-Ray Diagnostic Agents—2-(3,5-Diiodo-4-Hydroxybenzyl)-Benzoic Acid. Domenick Papa. Arch. Biochem. **23:** 163–165, August 1949.

In view of the pharmacological and clinical interest in 2-(3,5-diiodo-4-hydroxybenzyl)-benzoic acid as a possible cholecystographic agent, the author records the synthesis of this compound.

The requisite intermediate, 2-(*p*-hydroxybenzyl)-benzoic acid was obtained in 80 per cent yield by the Raney reduction of 2-(*p*-hydroxybenzoyl)-benzoic acid, iodinated with potassium triiodide giving 83 per cent yield.

RADIOTHERAPY

Pre-operative Radiotherapy in the Treatment of Osteogenic Sarcoma: Preliminary Communication. R. Kaye Scott. M. J. Australia **2:** 304–305, Aug. 27, 1949.

The author advocates the use of intensive roentgen therapy as a preoperative measure in osteogenic sarcoma. A beam with a half-value layer of 2.0 mm. of copper is employed with a skin dose of 150 to 200 r given four to five times per week for ten weeks. A tumor dose of 4,500 r is attained in the first ten-week course. Courses are repeated at regular intervals after a rest period of ten weeks. Tumor dosage in the subsequent courses may be slightly lower than in the first course. Eighteen months following the beginning of radiation therapy, amputation is carried out provided no metastasis has developed.

Twenty-two patients with osteogenic sarcoma have been treated under this regime. Local response to irradiation without development of metastasis in eighteen months was found in 6. Two additional recent cases have been observed for fourteen months without the development of metastases. In 5 cases metastasis occurred within twelve months. No significant response to irradiation was noted in 5 cases. In 4 cases of sarcoma developing in Paget's disease, no improvement occurred.

DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

Spinal Haemangioma Treated by Deep X-Ray Therapy. H. R. Holmes. South African M. J. **23:** 725–726, Aug. 27, 1949.

A 76-year-old female complained of epigastric pain and weakness of the extremities. Roentgenograms of the spine revealed enlargement, rarefaction, vertical striation, and slight compression of the third lumbar vertebra. The diagnosis was hemangioma.

A course of deep x-ray therapy (h.v.l. 1.1 mm. Cu) was given with a daily dose of 250 r to each of two medially oblique lumbar paravertebral fields, to a total dose (air) of 2,500 r per field. The course was repeated twice, at intervals of six months, after which symptoms improved and radiologically the vertebra showed increased trabeculation and a thickened, well defined cortex.

Four roentgenograms.

DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

Extramedullary Plasmacytoma of the Bladder with Local Metastasis. A. D. Gorfain. California Med. **71:** 147–149, August 1949.

Plasmocytoma, or plasma-cell tumor, rarely occurs outside the bone marrow; Hellwig (Arch. Path. **36:** 95, 1943) found 129 examples reported, only 2 of which were in the genito-urinary tract—one in the kidney and one in the spermatic cord. The author mentions a third case from the French literature, involving the urinary bladder (Marion and Leroux: J. d'urol. **18:** 121, 1924). He believes his own case to be unique in the American literature.

Microscopic hematuria had been detected in this instance over a period of five years before the bladder tumor was seen cystoscopically. Cystoscopy six months before the discovery had been essentially normal, although the author believes the tumor must have been present as a very small lesion at that time. Resection of the growth and the surrounding bladder wall was done, but there was a recurrence in five months. Partial excision of this new lesion was followed by roentgen therapy, and eighteen months later there was no evidence of disease. The details of treatment are presented, and the conclusion is drawn that irradiation, to which this tumor is extremely sensitive, should be given immediately after the diagnosis is made.

In this case a skeletal survey, bone marrow studies, examination for Bence-Jones protein in the urine and blood protein determinations ruled out the presence of disease elsewhere.

One photomicrograph.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Reticulo-Endotheliosis. Hand-Schüller-Christian Disease and the Rarer Manifestations. William S. Wallace. Am. J. Roentgenol. **62:** 189–207, August 1949.

Reticulo-endotheliosis and its variants are of primary concern to the radiologist from the point of view of both diagnosis and therapy.

Hand, who described the first case two years before the discovery of x-rays, regarded it as a peculiar reaction to a generalized tuberculosis from which his patient was suffering. In 1915, Schüller described 2 cases, under the designation "anomaly of the skeleton as a result of disease of the hypophysis." Christian, in 1918, reported another case which was similar to the 2 reported by Schüller and concluded that the entity was due to pituitary dysfunction.

Aschoff had described the reticulo-endothelial system and had suggested its role in intermediary fat metabolism. On the basis of this and a review of 12 reported cases and 2 of his own, Rowland in 1928 formulated his hypothesis of the development of Hand-Schüller-Christian disease. He thought that a hyperabundance of cholesterol lipids in the circulating blood produced an injury to the vascular lining, with perivascular infiltration which called forth many reticulo-endothelial

cells to phagocytize this foreign material, the process continuing to a point where tumefaction occurred with resultant aseptic necrosis and fibrosis.

Wallgren disagreed with this theory. He attributed the primary disturbance to abnormal infiltration of the reticulo-endothelial cells with the lipoid deposits being secondary. He based his view on the frequent occurrence of reticulo-endothelial hyperplasia without the presence of foam cells. For this same reason he objected to the classification of Hand-Schüller-Christian disease with the other group of lipoid storage disorders, such as Gaucher's and Nieman-Pick's diseases. Hypercholesteremia is a definitely inconstant finding in Hand-Schüller-Christian disease.

Letterer-Siwe disease is a variant in infants and young children and has a fatal prognosis. Inability of the very young to immobilize the hyperplastic reticulo-endothelial cells by lipoid deposits seems to account for the rapidly fatal course. Even in the older age groups, some cases of Hand-Schüller-Christian disease are subacute, and the author had 2 cases which ran a rapid terminal course, due perhaps to fatigue with loss of reparative ability.

The author presents 7 cases. The typical triad of skull defect, exophthalmos, and diabetes insipidus were not always present. All the patients had rather typical skull changes. Slight eosinophilia and moderate anemia were other common findings. Bony involvement of the mandible and maxilla was frequent. Gingivitis, malnutrition, and growth delay were noted. Less often the patients presented jaundice, aural discharge, hemorrhagic diathesis, generalized lymphadenopathy, and skin lesions.

The technic of x-ray treatment varied, but the author thinks 200-kv. apparatus is sufficient. He used adequate filtration to insure good depth dosage with minimum skin dosage (217 kv.p., 50 cm. distance, filtration 1 mm. Cu. 5 mm. Al, h.v.l. 1.5 Cu.). A course of therapy usually consisted of 1,000 r in air to each area in twelve days. Several courses were given over a period of years if necessary, and this improves the immediate as well as the final prognosis. All but one of the patients showed marked improvement.

Twenty-four roentgenograms.

JOHN S. SCOTT, M.D.
Indiana University

Value of Roentgen Therapy in the Treatment of Whooping Cough. J. Prouzet and Escande. J. de radiol. et d'électrol. **30:** 526–527, 1949. (In French)

One-hundred and thirty-eight patients with whooping cough were treated by roentgen therapy. For the first 50 patients treatment was given at 100 kv., 5.0 mm. Al filter, 40 cm. distance, 100 r per dose; for the last 88 at 140 kv., 0.5–1.0 mm. Cu filter, 50 cm. distance, 50 r per dose. Anterior and posterior thoracic fields were used. A maximum of five treatments was given, with intervals of three days. Treatment was considered successful in 96 per cent of the patients. Nocturnal cough disappeared after the second treatment and the diurnal cough disappeared after the fourth or fifth treatment.

One table.

CHAS. NICE, M.D.
University of Minnesota

Determination of the Energy Distribution of Bremsstrahlung [X-Rays] from 19.5 Mev Electrons. H. W. Koch and R. E. Carter. Physical Rev. **77:** 165–174, Jan. 15, 1950.

X-rays from a betatron with thin platinum target were passed in pulses through a cloud chamber. The energy of the electron pairs produced was estimated by their curvature in magnetic field. In this way the energy (frequency, wave length) spectrum was arrived at. The clinical radiologist is presumably little interested in the details of composition of a betatron beam. The novel method of measuring short wave lengths for which crystal spectrography is impractical is interesting.

R. R. NEWELL, M.D.
San Francisco, Calif.

Possible Techniques in Direct-Electron-Beam Tumor Therapy. W. H. Bostwick. Physical Rev. **77:** 564, Feb. 15, 1950.

In a letter to the editor the author gives calculations of lateral diffusion of a multi-megavolt electron beam and points out how badly it can be expected to weaken the high depth dose expected in electron-beam therapy. He shows the advantages of putting the patient in a strong magnetic field. He also suggests putting the beam in through a deep narrow incision held open by a tube.

R. R. NEWELL, M.D.
San Francisco, Calif.

RADIOISOTOPES; ELEMENT 97

Late Radiation Effects in Roentgen Therapy for Hyperthyroidism. Their Possible Bearing on the Use of Radioactive Iodine. Letter to the Editor. Edith H. Quimby and Sidney C. Werner. J. A. M. A. 1046–1047, July 23, 1949.

Since radioactive iodine, especially the isotope of 8-day half-life, I^{131}, has been employed in treatment of hyperthyroidism in several clinics during recent years, the question of the possibility of late radiation changes leading to malignant degeneration has been raised. The authors therefore sent a questionnaire to a group of radiologists and thyroid specialists who might have had long-term experience in the treatment of toxic goiter with roentgen rays. The questions asked were as follows:

1. Have you ever seen a cancer arising in a thyroid gland in a case of hyperthyroidism which had been previously treated with roentgen rays? If so, was the gland nodular?

2. Have you ever seen a cancer arise in adjacent structures in a case of hyperthyroidism previously treated with roentgen rays?

3. Have you ever seen a cancer arise in a normal thyroid gland when that region had been in the field of roentgen ray treatments for another condition?

4. Have you ever seen a cancer of the thyroid develop in a patient who had undergone any treatment for hyperthyroidism other than radiation? If so, was the gland nodular?

Responses were received from 70 radiologists and 31 thyroid specialists; of the latter, 4 declared themselves unqualified to give information. A total of 71 (53 radiologists and 18 medical specialists) returned a categoric No to all questions.

In answer to the first question, 10 cases were reported of cancer arising in thyroid glands in which roentgen rays had been previously given for hyperthyroidism. About 2 of them no definite information is available. In 2 others there were nodular glands, in which cancer is known to arise with some frequency; in 2 cancer was found within three or four years, which is early for the development of radiation-induced cancer when dosage has not been excessive; in 3 cases it is doubtful whether the doses were large enough to cause late damage. This leaves only 3 in which the history indicates even the possibility that roentgen rays were implicated in the production of cancer.

In response to the second question, 8 radiologists reported having seen cancer of the skin of the neck following roentgen treatment for hyperthyroidism; some of these stated that they had seen several cases. In addition, 2 cases of cancer of the larynx were reported, and 1 each of the esophagus and trachea.

As to the third question, no one had seen cancer produced in a normal thyroid gland which fell within the field of irradiation for some other malignant condition, such as cancer of the larynx.

In answer to question 4, 9 physicians or radiologists had seen cancer arise in hyperthyroid glands treated otherwise then by irradiation. Both surgical and medical treatments were specified. Some cases were said to have been of toxic nodular goiter, but 2 were stated to have been of primary hyperplastic, not nodular, goiter.

From the responses to the questionnaire, it appears that the possibility of late malignant degeneration is negligible following roentgen therapy for toxic goiter. It may be presumed that the hazard is not much greater for radioactive iodine therapy, but this cannot be verified for a number of years. Accordingly, for some years at least, everyone employing this method should make all possible efforts to follow cases persistently. Radioactive iodine should not be used indiscriminately. Reasonable criteria should be established for the selection of patients, and dosage levels should be based on careful calculations. In addition, careful histologic study of any thyroid material obtained at operation or autopsy at both short and long intervals after I^{131} therapy should be undertaken.

Problem Cases of Toxic Diffuse Goiter Treated with Radioactive Iodine. Myron Prinzmetal, Clarence M. Agress, H. C. Bergman, and Benjamin Simkin. J. A. M. A. **140:** 1082–1089, July 30, 1949.

Eighteen cases of severe toxic diffuse goiter illustrating five types of complication were treated with radioactive iodine with only one frank failure. The complications were: (1) congestive heart failure, (2) psychosis or extreme emotional instability, (3) extreme toxicity, (4) recurrence of toxicity after thyroidectomy, and (5) in a single case thyroid cancer.

Interesting case reports are given in detail, illustrating each type of case and demonstrating the safety, efficiency, and convenience of this form of therapy. The poorest results were obtained in the cases of extreme toxicity: of the 3 patients treated, only 1 had a complete remission of thyrotoxicosis. Partial remission was obtained in another, while the third showed no response. The article is recommended for anyone seeing cases of thyrotoxicosis.

One table; 5 graphs. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Radioactive Iodine (I^{131}) in the Diagnosis of Lingual Thyroid. Herman M. Nachman, Vernon Crawford, and I. A. Bigger. J. A. M. A. **140:** 1154–1156, Aug. 6, 1950.

Radioactive iodine was given to a girl 11 years of age in tracer amounts (10 microcuries) to aid in the preoperative evaluation of a suspected lingual thyroid, subsequently proved to be such microscopically and by radioautograph.

Persistence of thyroid tissue at the site of its origin, the foramen cecum at the base of the tongue, is an uncommon condition, which is amenable to surgical treatment. The present report directs attention to the use of radioactive iodine and the radioactive tracer technic as an aid in the preoperative evaluation of such thyroid anomalies.

One drawing, one photomicrograph.

DANIEL WILNER, M.D.
Atlantic City, N. J.

Distribution of Radioactive Iodine in Rats With and Without Walker Tumor 256 After Injection of Radioactive Sodium Iodide. Charles D. Stevens, Paul H. Stewart, Patricia M. Quinlin, and Mary Ann Meinken. Cancer Research **9:** 488–497, August 1949.

At intervals up to four days after subcutaneous injection of young male rats with sodium iodide labeled with radioactive iodine, the animals were killed and the concentration of the injected iodine in various tissues was measured. It was found that:

(1) The majority of rats with implants of Walker tumor 256 had lower concentrations of the injected iodine in their thyroid glands and other tissues than did control rats grouped with them according to size and treated similarly. These differences probably resulted from lower concentrations of the injected iodine in the blood sera of the tumor-bearing rats. The cause of this difference in the sera is undetermined.

(2) The distribution of injected iodine was like that of chloride (see Wallace and Brodie: J. Pharmacol. & Exper. Therap. **61:** 397, 412, 1937) during the first day after injection in the majority of tissues examined. Concentrations of injected iodine were higher, however, than would be suggested by published data on the chloride content, in the thyroid, stomach, forestomach, ear pinna, and liver, and lower in the brain and testes.

(3) The concentration of injected iodine in the tissues at one-half hour after injection changed during the eleven-day period in which the animals were killed. The concentration in the thyroid increased, and the concentrations in the other tissues decreased. The decreasing concentrations suggest decreasing proportions of extracellular fluid. In this eleven-day period the surviving rats increased 70 per cent in body weight.

(4) The decrease in concentration of that part of the injected iodine which remained in solution after precipitation of the serum proteins with trichloroacetic acid did not occur as a simple logarithmic function of time during the four days after injection. This was true after injection of either 0.07 or 70 micrograms of iodine per 100 grams of body weight.

Six charts; 4 tables.

Use of Cobalt^{60} in Radiotherapy. Robert Coliez. J. de radiol. et d'électrol. **30:** 518–524, 1949. (In French)

The production, disintegration and use of $_{27}Co^{60}$ as a radiotherapeutic agent is discussed. This radioactive

element may be produced by bombardment of stable cobalt ($_{27}Co^{59}$) with deuterons accelerated in the cyclotron or by bombardment with neutrons in a pile. The agent is used as an alloy with 55 per cent nickel, in the form of needles or bombs. The maximum beta particle energy is 0.31 Mev., and so the filter may be 1.0 mm. of nickel. The half-life of 5.3 years renders the isotope suitable for therapy in man if decay factors are watched. Since cobalt is much more abundant than radium, and therefore less expensive, many more possibilities of various technics of teletherapy are envisioned for the future.

Eight diagrams; 1 table.

CHAS. NICE, M.D.
University of Minnesota

Element 97. S. G. Thompson, A. Ghiorso, and Glenn T. Seaborg. Physical Rev. **77:** 838, March 15, 1950.

In a letter to the editor dated Jan. 23, 1950, the authors report the production of a new element, No. 97. They propose the name Berkelium (from the City of Berkeley), parallel to the corresponding element of the rare earth series, Terbium, from the town of Ytterby. The new element was made by bombardment of Americium 241 with helium ions in the 60-inch cyclotron. It has a half-life of 4.8 hr. [We read in the newspapers about still another new element produced by Seaborg, namely No. 98, to be called Californium].

R. R. NEWELL, M.D.
San Francisco, Calif.

EFFECTS OF RADIATION

Necrosis of the Brain Due to Radiation Therapy. Clinical and Pathological Observations. Joe Pennybacker and Dorothy S. Russell. J. Neurol., Neurosurg. & Psychiat. **11:** 183–198, August 1948. **Experimental Radio-Necrosis of the Brain in Rabbits.** Dorothy S. Russell, C. W. Wilson, and Katharine Tansley. J. Neurol., Neurosurg. & Psychiat. **12:** 187–195, August 1949.

In the first paper the authors present 5 cases in which massive focal necrosis and gliosis of the brain followed therapeutic irradiation. The latent period varied from nine months to five years. In 2 cases the changes occurred in areas that were presumed, on reasonable grounds, to have been previously normal; in the remainder the picture was complicated by a pre-existing or coexisting tumor. Nevertheless, the general pattern of the tissue alterations was consistent throughout the series and agreed with descriptions already published by others.

The second paper describes the authors' attempt to reproduce the lesions seen in the human subject and also to study their evolution and, in particular, the part played by structural alterations in the blood vessels. It was found that a single surface dose of 2,850 r will produce delayed irradiation necrosis in the rabbit's brain after a latent period of approximately one hundred days. The latent period was lengthened by reducing the dose to 2,440 r. The physical factors were: 200 kv., filtration 0.5 mm. Cu and 1.0 mm. Al to give a half-value layer of 0.95 mm. Cu; field size 3 × 4 cm.; surface dose-rate 154.5 r per minute; focus-skin distance 25.5 cm. The approximate depth doses were: 1 cm. depth, 85 per cent; 2 cm. depth, 70 per cent; 3 cm. depth, 57 per cent.

The initial histologic changes consisted of minute foci of hemorrhage and necrosis which are intimately related to the perforating vessels and, in particular, capillaries. Increase of capillary permeability accompanied the established lesion but was not demonstrated at earlier stages.

The lesions, when once initiated, appeared to extend rapidly and to progress to non-irradiated parts of the brain. They were characterized, in later stages, by pronounced gliosis, and by progressive degeneration and sclerosis of the adjacent vessels. The neurones were only focally and secondarily affected. The meninges and their blood vessels were unaffected, and the superficial parts of the cerebrum escaped, even though the cerebellar cortex might be extensively damaged.

Both papers are illustrated by photographs and photomicrographs showing the changes in the brain.

Erythema Multiforme Following High Voltage Roentgen Therapy. Review of the Literature and Report of Three Cases. Harry L. Arnold, Jr. Arch. Dermat. & Syph. **60:** 143–149, August 1949.

At least two types of cutaneous reaction to roentgen irradiation may occur, in addition to the primary reaction which is familiar to the radiologist who administers high-voltage roentgen therapy, a relatively common localized form, which may be called infectious eczematoid dermatitis, and a relatively rare generalized form, which seems best classified simply as erythema multiforme. The latter form may also be caused by drugs, and it may therefore be difficult or even impossible to be sure in a given case whether irradiation is responsible. Holzknecht's original explanation—that the eruption results from absorption of toxic materials from the irradiated tissues (Arch. f. dermat. u. syph. **66:** 71, 1903)—seems most reasonable. Three cases seen by the author in Honolulu are reported. The disorder seems to run a benign course in almost all instances, the most serious eventuality being the development of exfoliative dermatitis. Antihistaminic drugs may be of value in treatment but, in general, supportive measures are probably more important.

Three photographs.

Contact Therapy in Chronic Professional Radiodermatitis. Aldo Perussia. Radiol. med. (Milan) **35:** 555–569, July 1949. (In Italian)

The author has had occasion to treat three radiologists who after many years of professional life had developed a total of eleven warty or neoplastic lesions implanted on various degrees of radiodermatitis of the hands. On the basis of this experience, he states that lesions larger than 2.5 cm. should be treated by surgical excision. In smaller lesions, one should carefully estimate the damage already done to the capillary bed by previous exposure to radiation. If the capillary bed is not too bad, the author suggests the use of contact therapy and employs daily dosages of 500 r for a total of 2,000 or 4,000 r. The advantages of contact therapy in hands already damaged by radiation are to be found in the low depth dose. This, of course, limits its use to superficial lesions not deeper than a few millimeters.

CESARE GIANTURCO, M.D.
Urbana, Ill.

Studies on the Mechanism of Action of Ionizing Radiations. IV. Effect of X-Ray Irradiation on the Respiration of Sea Urchin Sperm. E. S. Guzman Barron, Betty Gasvoda, and Veronica Flood. Biol. Bull. **97:** 44–50, August 1949. **V. Effect of Hydrogen Peroxide and of X-Ray Irradiated Sea Water on the Respiration of Sea Urchin Sperm and Eggs.** E. S. Guzman Barron, Veronica Flood, and Betty Gasvoda. Ibid., pp. 51–55.

The respiration of dilute suspensions of sea urchin sperm was inhibited by x-ray irradiation. A dose of 20,000 r produced an inhibition of 66 per cent.

Further experiments on the effect of H_2O_2 and irradiated sea water failed to support the belief that H_2O_2 is an important factor in x-ray toxicity to sea urchin sperm.

Six charts; 6 tables.

DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

Morphological and Biological Characteristics of X-Ray Induced Transplantable Ovarian Tumors. Talia Bali and Jacob Furth. Cancer Research **9:** 449–472, August 1949.

Exposure of the ovaries of mice to x-rays causes the development of tumors of different sorts. The authors succeeded in transplanting five types in series: granulosa tumors, luteomas, tubular adenomas, sarcomas, and angioendotheliomas.

Granulosa tumors occur in such a wide range of morphologic forms and simulate so many different types of neoplasm that their identification on a morphological basis alone is often not possible. Common to all granulosa growths is the ability to produce or initiate production of estrogens and plethorins (a substance that raises blood volume), although not all tumor-bearing hosts show effects of these substances. Manifestations of estrogen and plethorin stimulation can occur independently, although both are related to activities of granulosa cells. No evidence was found to indicate that any cell other than a variant of the granulosa cells secretes estrogen.

Well developed granulosa tumors did not change into luteomas. After a few transplantations, each strain had certain morphological features that remained true through numerous subpassages.

All transplantable luteomas studied produced secondary changes indicative of progestin production.

The tubular adenomas are derivatives of the germinal epithelium. Those transplanted were benign and of exceedingly slow growth. In the course of subpassage, sooner or later most of them either changed into or were overgrown by granulosa cells.

Male hosts are more susceptible to grafts of tubular adenoma and of granulosa tumors than females. This sex influence does not seem to be due to a gonadal hormone, since it is usually magnified by gonadectomy.

Spleen and liver are better soils for granulosa grafts than the subcutaneous tissue; the success of splenic grafts is not necessarily due to inactivation of estrogens in the liver.

In the genesis of these tumors two major forces are postulated: direct and delayed x-ray effect, and a hormonal "imbalance." Both require a more precise analysis to unravel the complex sequence of events initiated by irradiation of the ovaries. The exposure to x-rays may last only for seconds, but the chain of events which follows covers the entire life span of the animal.

Fifty photomicrographs; 4 tables.

Radioresistant Cells in Certain Radiosensitive Tissues of Swine Exposed to Atomic Bomb Radiation. John L. Tullis. Arch. Path. **48:** 171–177, August 1949.

In swine exposed to atomic bomb radiation at Bikini it was found that the reticular cells of the lymphoid organs and the bone marrow and the indifferent cells of the immature testis and the primordial ova, all of which cells are the so-called stem cells of their respective highly radiosensitive organs, were comparatively radioresistant, representing an important exception to the law of Bergonié and Tribondeau that primitive cells are more sensitive to radiation than specialized cells.

The importance of this observation lies in its significance for recovery of the organism from radiation injury. It is apparent that if treatment during the acute phase of the injury is successful in maintaining life, there is histologic evidence that regeneration of radiosensitive cells can be accomplished by the surviving stem cells.

Indirect Effect of X Rays on the Synthesis of Nucleic Acid in Vivo. Barbara E. Holmes. Brit. J. Radiol. **22:** 487–491, August 1949.

That the synthesis of thymonucleic and ribonucleic acids is inhibited in irradiated tumors and also in other tumors in the same animal which are not directly irradiated has long been known. In an attempt to find out more about the indirect effect, studies were made on Jensen rat sarcomas. A tumor in one thigh was irradiated with 2,000 r in seventeen minutes, while a tumor of comparable size in the opposite thigh was shielded. Measurements in dead animals under similar conditions indicate that the shielded tumor received between 17 and 25 r during the irradiation. This was found to be insufficient to produce inhibition of synthesis of the two acids. The animals were injected with P^{32} at varying intervals with relation to the time of irradiation and also were killed after varying periods.

In animals killed one hour after irradiation, definite reduction of synthesis of thymonucleic acid, to about 25 per cent of the normal, was observed in the irradiated tumors and to about 50 per cent in the shielded tumors. A similar but less marked effect was observed on ribonucleic acid. When the P^{32} was injected two hours after irradiation and the animal killed three hours after irradiation, the synthesis of ribonucleic acid was nearly normal in both irradiated and shielded tumors. Thymonucleic acid synthesis was normal in non-irradiated tumors and 60 per cent of normal in the others.

Cell counts show that even after five hours, when the synthesis of the acids is practically normal, there still are very few normal mitotic forms.

Three tables.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Studies of the Effects of Flavonoids on Roentgen Irradiation Disease. I. Protective Influence of Rutin in Irradiated Dogs. John B. Field and Paul E. Rekers. Am. J. M. Sc. **218:** 1–15, July 1949.

The authors report observations on the mortality and various hematological changes in dogs exposed to total-body x-radiation in a single dose of 350 r. The post-irradiation mortality of an untreated group of 37 animals was 60 per cent. Dogs given 150 mg. of rutin daily for seven days before, as well as following, irradiation showed a mortality of 11 per cent. When administration of rutin was not begun until the second day following irradiation, the mortality was 80 per cent.

Hematological studies indicated that the rate of anemia production and the magnitude of the increased sedimentation rate were reduced, while the erythroblast forms and nucleated red cells were increased in the rutin-treated animals.

The authors suggest that a primary cause of death of the irradiated animals was a bleeding tendency, which may be associated with a vascular dysfunction as well as a thrombocytopenia.

Ten graphs; 3 tables.

DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

Studies of the Effects of Flavonoids on Roentgen Irradiation Disease. II. Comparison of the Protective Influence of Some Flavonoids and Vitamin C in Dogs. John B. Field and Paul E. Rekers. J. Clin. Investigation **28:** 746–751, July 1949.

This report summarizes briefly observations on the activity of a variety of substances of the flavonoid and related groups and indicates the relationship of these substances with vitamin C in the irradiated dog.

As pointed out in Part I of this study (abstracted above), 60 per cent (22 of 37) of dogs succumbed with a prominent hemorrhagic syndrome following total body irradiation with a single dose of 350 r. Five flavanone substances (rutin, hesperidin, epimerized d-catechin, homoeriodictyol, morin) appeared roughly of equal activity in reducing the hemorrhagic signs of the irradiation disease when administered continuously preceding and following irradiation. Other flavonoids and their derivatives did not significantly reduce either the mortality or hemorrhagic changes in irradiated dogs. These included hesperidin methyl chalcone, esculin, quercitin, quercitrin, and naringin. With the benzopyrone, coumarin, 33 per cent (2 of 6) of the dogs succumbed, suggesting slight anti-irradiation activity.

Ascorbic acid alone failed to influence the course of irradiation disease and 50 per cent (6 of 12) of treated dogs died. However, when ascorbic acid was given simultaneously with quercitin, which by itself was ineffective, only 10 per cent (1 of 10) of the animals succumbed, exhibiting reduced signs of the disease.

It is suggested that previous misunderstanding of the nature of "vitamin P" has arisen from both the failure to recognize that several flavonone analogues possess very similar anti-hemorrhagic "activity" and that ascorbic acid has the capacity to potentiate "activity" in other flavanones.

Potent hyaluronidase inhibitors, as dopa and sodium gentisate, failed to influence the course of irradiation disease in dogs. It is suggested that the "spreading factor," hyaluronidase, plays little or no role in the evolution of this disorder.

Four tables.